Massachusetts Institute of Technology

Environmental Health and Safety Office
Building N52-496

77 Massachusetts Avenue
Cambridge, Massachusetts
02139–4307

October 6, 2008

US Environmental Protection Agency
NCCW GP Processing
Municipal Assistance Unit (CMU)
1 Congress Street Suite 1100
Boston, MA 02114-2023

Massachusetts Department of Environmental Protection
Division of Watershed Management
627 Main Street, 2nd floor
Worcester, MA 01608
Attention: Kathleen Keohane

Sent by email and Postal Service

RE: MIT NPDES permit MA0000795

Dear Ms Frawley and Ms. Keohane

Enclosed please find a Notice of Intent from the Massachusetts Institute of Technology to seek coverage under the under the National Pollutant Discharge Elimination System General Permit for Non-Contact Cooling Water (Permit No. MA250000). General permit coverage is being requested for two existing intake and outfall structures (designated 002 and 003) which are currently permitted under an individual permit MA0000795 located along the Charles River in Cambridge, Massachusetts.

This Notice indicates a significant reduction in flow from currently permitted levels from these sources.

Please do not hesitate to contact us if you have any questions or to discuss this request. I may be reached by phone at 617-452-2508.

Best Regards,

Dan Kallin
Environmental Officer

Enter your transmittal number → X224765
Transmittal Number

Your unique Transmittal Number can be accessed online: http://mass.gov/dep/service/online/trasmfrm.shtml or call MassDEP's InfoLine at 617-338-2255 or 800-462-0444 (from 508, 781, and 978 area codes).

Massachusetts Department of Environmental Protection

Transmittal Form for Permit Application and Payment

1. Please type or print. A separate Transmittal Form must be completed for each permit application.

2. Make your check payable to the Commonwealth of Massachusetts and mail it with a copy of this form to: DEP, P.O. Box 4062, Boston, MA 02211.

3. Three copies of this form will be needed.

Copy 1 - the original must accompany your permit application.
Copy 2 must accompany your fee payment.
Copy 3 should be retained for your records

4. Both fee-paying and exempt applicants must mail a copy of this transmittal form to:

MassDEP
P.O. Box 4062
Boston, MA
02211

*** Note:**
For BWSC Permits, enter the LSP.

A. Permit Information

BRPWM 11
1. Permit Code: 7 or 8 character code from permit instructions

General Permit for Non-Contact Cooling Water
2. Name of Permit Category

Non Contact Cooling water discharge
3. Type of Project or Activity

B. Applicant Information – Firm or Individual

Massachusetts Institute of Technology
1. Name of Firm - Or, if party needing this approval is an individual enter name below:

2. **Last Name** of Individual
3. **First Name** of Individual
4. MI

77 Massachusetts Avenue
5. Street Address

Cambridge	MA	02139	617-452-2508	
6. City/Town	7. State	8. Zip Code	9. Telephone #	10. Ext. #

Dan Kallin
11. Contact Person

dkallin@mit.edu
12. e-mail address (optional)

C. Facility, Site or Individual Requiring Approval

Massachusetts Institute of Technology
1. Name of Facility, Site Or Individual

77 Massachusetts Avenue
2. Street Address

Cambridge	MA	02139		
3. City/Town	4. State	5. Zip Code	6. Telephone #	7. Ext. #

314888	04 2103594	
8. DEP Facility Number (if Known)	9. Federal I.D. Number (if Known)	10. BWSC Tracking # (if Known)

D. Application Prepared by (if different from Section B)*

1. Name of Firm Or Individual

2. Address

3. City/Town | 4. State | 5. Zip Code | 6. Telephone # | 7. Ext. #

8. Contact Person

9. LSP Number (BWSC Permits only)

E. Permit - Project Coordination

1. Is this project subject to MEPA review? ☐ yes ☒ no
If yes, enter the project's EOEA file number - assigned when an Environmental Notification Form is submitted to the MEPA unit:

EOEA File Number

F. Amount Due

DEP Use Only

Permit No:

Rec'd Date:

Reviewer:

Special Provisions:

1. ☐ **Fee** Exempt (city, town or municipal housing authority)(state agency if fee is $100 or less).
There are no fee exemptions for BWSC permits, regardless of applicant status.
2. ☐ Hardship Request - payment extensions according to 310 CMR 4.04(3)(c).
3. ☐ Alternative Schedule Project (according to 310 CMR 4.05 and 4.10).
4. ☐ Homeowner (according to 310 CMR 4.02).

10005061	385.00	10/03/2008
Check Number	Dollar Amount	Date

10005061

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
ACCOUNTS PAYABLE, ROOM NE49-4064
77 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02139-4307

5-13/110

BANK OF AMERICA, N.A.
MALDEN, MA

VOID AFTER
90 DAYS

MONTH	DAY	YEAR
Oct	03	2008

PAY ***********385 DOLLARS AND 00 CENTS

AMOUNT
$ ***********385.00*

TO THE ORDER OF COMMONWEALTH OF MASSACHUSETTS
*

Theresa M. Stone

Authorized Signature

⑈10005061⑈ ⑆011000138⑆ 0200000046⑈

APPENDIX 5

Suggested Form for Notice of Intent (NOI) for the Noncontact Cooling Water General Permit

1. General facility information. Please provide the following information about the facility.

a) Name of facility: Massachusetts Institute of Technology		**Type of Business: Research Institue**
Facility Location Address : Massachusetts Institute of Technology 77 Massachusetts Avenue Cambridge, MA 02139-4307 **longitude:** 71° 05' 36" W **latitude:** 42° 21' 32" N	**Facility SIC codes:** 8221 Colleges, Universities and Professional Schools	**Facility Mailing Address (if not location address)** Massachusetts Institute of Technology Environment, Health and Safety Office, N52-496 77 Massachusetts Avenue Cambridge, MA 02139-4307 **Attn:** William VanSchalkwyk
b) Name of facility owner: Massachusetts Institute of Technology		**Email address of owner:** billv@mit.edu
Owner's Tel #: 617-253-9492 **Owner's Fax #** 617-258-6831		**Owner is (check one): 1. Federal____ 2. State _____ 3.Tribal_____** **4. Private__X___ 4. Other _______(Describe)**
Address of owner (if different from facility address) (same)		
Legal name of Operator, if not owner: ___Not Applicable____________ **Operator Contact Name:** ____________ **Operator Tel Number:** ____________ **Fax Number:** ____________ **Operator's email:** ____________ **Operator Address (if different from owner)** **d) Attach topographic map indicating the locations of the facility and the receiving water; all NCCW discharge points; upstream and downstream monitoring points. Map attached? _Yes_X_** (See Attachment A)		

e) Check Yes or No for the following:

1. **Has a prior NPDES permit been granted for the discharge? Yes** __X_ **No**____ **If Yes, Permit Number:** MA0000795
2. **Is the discharge a "new discharge" as defined by 40 CFR Section 122.22?** Yes (Outfall 003) **No** (Outfall 002)
3. **Is the facility covered by an individual NPDES permit? Yes**__X___ **No**_____ **If Yes, Permit Number:** MA0000795
4. **Is there a pending application on file with EPA for this discharge? Yes** __X__ **No** ______ **If Yes, date of submittal:** May, 8, 1990

2. Discharge information. Please provide information about the discharge, (attaching additional sheets as needed)

a) **Name of receiving water into which discharge will occur:** Charles River
State Water Quality Classification: Class B, Warm Water Fishery **Freshwater:** Yes **Marine Water:** No

b) **Describe the discharge activities for which the owner/applicant is seeking coverage:** See Attachment A

c) **FOR MASSACHUSETTS FACILITIES ONLY: Engineering Calculations: Submit the completed engineering calculation of the surface water temperature rise as shown in Attachment A of the General Permit. Check if attached:** X (See Attachment A)

d) **Number of outfalls:** 2, designated Outfall 002 and Outfall 003

For each outfall:

Outfall 002 (Alternator Cooling)

e) **What is the maximum daily and average monthly flow of the discharge? Note that EPA will use the flow reported here as the facility's permitted effluent flow limit.** **Max Daily Flow** 180,000 GPD **Average Flow** 1.8 MG/month (See Attachment A)

f) **What is the maximum daily and average monthly temperature of the discharge (in degrees F)? Max Temp.** 83°F **Average Temp.** < 5°F above ambient in summer, up to 20°F in winter.

g) **What is the maximum and minimum monthly pH of the discharge (in s.u.)? Max pH** 8.3 S.U. **Min pH** 6.0 S.U.
The minimum pH value of 6.0 S.U. has been adopted as background pH in the lower Charles River. The makeup water source has been observed to approach 6.0 S.U. under natural background conditions.

h) **FOR MASSACHUSETTS FACILITIES ONLY: Is the source water of the NCCW potable water? Yes_______ No ___X___ If Yes, EPA will calculate the Total Residual Chlorine limit for facilities located in Massachusetts.**

i) **Is the discharge continuous? Yes _______ No ___X___ If no, is the discharge periodic (P) (occurs regularly, i.e., monthly or seasonally, but is not continuous all year) or intermittent (I) (occurs sometimes but not regularly) or both (B) Intermittent (research related)**
If (P), number of days or months per year of the discharge ______ and the specific months of discharge ____________________________;
If (I), number of days/year there is a discharge. (See Attachment A)

j) **Latitude and longitude of each discharge within 100 feet: Outfall 1: long.**___NA____ **lat.**___NA____**; Outfall 2: long.** 71° 05' 46.46" W **lat.** 42° 21' 20.37" N **; Outfall .3: long.** 71° 05' 28.16" W **lat.** 42° 21' 26.70" N **(See http://www.epa.gov/tri/report/siting_tool)**

Outfall 003

j) **What is the maximum daily and average monthly flow of the discharge? Note that EPA will use the flow reported here as the facility's permitted effluent flow limit.** **Max Daily Flow** 500,000 GPD **Average Flow** TBD

k) **What is the maximum daily and average monthly temperature of the discharge (in degrees F)? Max Temp.** 83°F **Average Temp.** TBD

l) **What is the maximum and minimum monthly pH of the discharge (in s.u.)? Max pH** 8.3 S.U. **Min pH** 6.0 S.U.

The minimum pH value of 6.0 S.U. has been adopted as representative of background pH in the lower Charles River.

m) **FOR MASSACHUSETTS FACILITIES ONLY: Is the source water of the NCCW potable water? Yes_______ No ___X___ If Yes, EPA will calculate the Total Residual Chlorine limit for facilities located in Massachusetts.**

n) **Is the discharge continuous? Yes** ___TBD____ **No** ______ **If no, is the discharge periodic (P) (occurs regularly, i.e., monthly or seasonally, but is not continuous all year) or intermittent (I) (occurs sometimes but not regularly) or both (B) Intermittent (research related) If (P), number of days or months per year of the discharge ______ and the specific months of discharge ______________________________; If (I), number of days/year there is a discharge**

Detailed design data for the discharge will be available by January 2009.

k) Provide the reported or calculated seven day-ten year low flow (7Q10) of the receiving water _______21.3_________ **cfs**
Please attach any calculation sheets used to support stream flow and dilution calculations. See General Permit Attachment B for equations and additional information.

MASSACHUSETTS FACILITIES: See Part 3.4 and Appendix 1 of the General Permit for more information on ACEC.
Areas of Critical Environmental Concern (ACEC): Does the discharge occur in an ACEC? Yes ______ No __X___
If yes, provide the name of the ACEC:

3. NCCW Source Water Information. Please provide information about the NCCW source water, using separate sheets as necessary:

a) Indicate source of the NCCW (i.e., municipal water supply, private well, surface water withdrawal, groundwater): **Source: Surface Water Withdrawal** **Name of Source Water:** Charles River ________________ **Is the source registered/permitted under MA Water Management Act or NHDES Water User Registration Rule (Env Wq 2202)?**	**b) If source water is surface water:** **i) Is it a freshwater river or stream Yes__X___ No_____** **ii) Is it a lake? _________ reservoir?______________** **iii) Is it tidal river? _________ estuary? ___________ ocean?____________** **c) Is the source water groundwater? Yes ______ No ___X___ If yes, see Appendix 8 and submit effluent and surface water test results, as required in Part 5.4 of the General Permit.**

Yes__X__ **No**______ (Non Consumptive Use) **If yes, registration number:** #3-20-049-03	**d) Does the facility use both a primary and backup source of noncontact cooling water?** **Yes** ________ **No** ____X______ **If yes, attach information that identifies and explains the primary and backup sources of noncontact cooling water for and how often the backup supply was used in last three years.**

4. Best Technology Available for CWIS

Are you subject to BTA requirements at Part 4.2 of the General Permit? (Facility's discharge is covered by this General Permit and the facility withdraws noncontact cooling water from surface source water). Yes_X___ **No**_______ **If No, explain:**

If YES, attach the facility-specific BTA description as required in Part 4.3 of the General Permit. For additional information and guidance, see Questions 13-23 of the NCCW Fact Sheet, posted at http://www.epa.gov/region1/npdes/nccwgp.html. **Provide a map showing the location of each CWIS intake structure; NCCW outfall(s) and any CWIS feature referred to in the BTA description.** (See Attachment A)

Include in your description:

___X__ **Measures to meet the General Permit Part 4.3.a general BTA requirements, including documentation that describes the facility's monitoring program for impinged fish and/or invertebrate; or the required alternative monitoring plan frequency and/or protocol**
___X__ **A characterization of the source water body's aquatic life habitat in the vicinity of each CWIS during the seasons when the CWIS may be in use**
___X__ **The attributes of the current CWIS**
___X__ **Design measures of the CWIS**
___X__ **Operation measures of the CWIS**
___X__ **Historical occurrence of impinged fish for the past five years**
______ **If applicable, a demonstration that the facility's intake rate is commensurate with a closed-cycle recirculation system**
______ **Other components to reduce impingement and/or entrainment of aquatic life**

4. BTA FOR CWIS CONTINUED:

Intake 002

Provide the following information for each CWIS to support your attached facility-specific BTA description.
Design capacity of the of the CWIS 0.18 mgd
Maximum monthly average intake of the CWIS during the previous five years 1.8 million gallons/month **Month in which this flow occurred** (estimated maximum based on 5-days per week, 12-hours per day, 4 weeks per month)
Maximum through-screen design intake velocity 0.01 feet/second (fps) (at the intake opening to the Charles River (See Attachment A)

For facilities where the CWIS is located on a freshwater river or stream, provide the following information:
The source water's annual mean flow 384 cubic feet/second (cfs) **as available from USGS or other appropriate source**
The design intake flow as a % of the source water's annual mean flow 0.072% **Attach calculations if equal to or less than 5% of annual mean flow.**
The source water's 7Q10 21.3 **cfs. See Attachment B of the General Permit for more information on 7Q10 determinations.**
The design intake flow as a percent of the source water's 7Q10 1.3%

Intake 003

Provide the following information for each CWIS to support your attached facility-specific BTA description.
Design capacity of the of the CWIS 0.5 mgd
Maximum monthly average intake of the CWIS during the previous five years 0 **Month in which this flow occurred** (Not active)
Maximum through-screen design intake velocity 0.05 feet/second (fps) (See Attachment A)

For facilities where the CWIS is located on a freshwater river or stream, provide the following information:
The source water's annual mean flow 384 cubic feet/second (cfs) **as available from USGS or other appropriate source**
The design intake flow as a % of the source water's annual mean flow 0.2 % **Attach calculations if equal to or less than 5% of annual mean flow.**
The source water's 7Q10 21.3 **cfs. See Attachment B of the General Permit for more information on 7Q10 determinations.**
The design intake flow as a percent of the source water's 7Q10 3.6 %

5. Contaminant Information

If applicable, attach a listing of all non-toxic pH neutralization and/or dechlorination chemicals used, including chemical name and manufacturer; maximum and average daily quantity used as well as the maximum and average daily expected concentrations (mg/l) in the NCCW discharge, and the vendor's reported aquatic toxicity (NOAEL and/or LC_{50} in percent for aquatic organism(s)). (Not Applicable)

6. Determination of Endangered Species Act Eligibility: Provide documentation of ESA eligibility as required at Part 3.4 and Appendix 2, Part C, Step 4, of the General Permit. In addition, respond to the following questions.

a) Are any listed threatened or endangered species, or designated critical habitat, in proximity to the discharge? Yes____No__X__

b) Has any consultation with the federal services been completed? Yes_ __ No_X__

c) Is consultation underway? Yes __X__ No____ (informal consultation)

d) What were the results of the consultation with the U.S. Fish and Wildlife Service and/or NOAA Fisheries Service (check one):
a "no jeopardy" opinion _____or written concurrence__X__ on a finding that the discharges are not likely to adversely affect any endangered species or

e) Which of the five eligibility criteria listed in Appendix 2, Section B (A,B,C,D or E) have you met? ___B______(In process, See Attachment A)

f) Attach a copy of the most current federal listing of endangered and threatened species from the USF&W web site listed in Appendices 2, 2.1 and 4

7. Documentation of National Historic Preservation Act requirements: Please respond to the following questions:

Are any historic properties listed or eligible for listing on the National Register of Historic Places located on the facility site or in proximity to the discharge? Yes __X___ No ____

Have any State or Tribal historic preservation officers been consulted in this determination? Yes __X____ or No _____ If yes, attach the results of the consultation(s). Informal consultation has been initiated, See Attachment A

c) Which of the three National Historic Preservation Act requirements listed in Appendix 3, Section C (1,2 o3) have you met? ____2_______

8. Supplemental Information: Please provide any supplemental information. Attach any analytical data used to support the application. Attach any certification(s) required by the general permit (See Attachment A)

9. Signature Requirements: The Notice of Intent must be signed by the operator in accordance with the signatory requirements of 40 CFR Section 122.22 (see below) including the following certification:

I certify under penalty of law that (1) no biocides or other chemical additives except for those used for pH adjustment and/or dechlorination are used in the noncontact cooling water (NCCW) system; (2) the discharge consists solely of NCCW (to reduce temperature) and authorized pH adjustment and/or dechlorination chemicals; (3) the discharge does not come in contact with any raw materials, intermediate product, water product (other than heat) or finished product; (4) if the discharge of noncontact cooling water subsequently mixes with other wastewater (i.e.stormwater) prior to discharging to the receiving water, any monitoring provided under this permit will be only for noncontact cooling water; (5) where applicable, the facility has complied with the requirements of this permit specific to the Endangered Species Act and National Historic Preservation Act; and (6) this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted.

Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, I certify that the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I certify that I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Facility Name: Massachusetts Institute of Technology

Operator signature: William C Van Schalkwyk

Title: Managing Director, EHS Programs

Date: Oct. 3, 2008

Federal regulations require this application to be signed as follows:

1. For a corporation, by a principal executive officer of at least the level of vice president;

2. For a partnership or sole proprietorship, by a general partner or the proprietor, respectively, or,

3. For a municipality, State, Federal or other public facility, by either a principal executive officer or ranking elected official.

ATTACHMENT A

Supporting Information

Notice of Intent for Coverage Under the Massachusetts General Permit for Non-Contact Cooling Water

Massachusetts Institute of Technology

Attachment A

The Massachusetts Institute of Technology (MIT) is submitting a Notice of Intent (NOI) to seek coverage under the National Pollutant Discharge Elimination System General Permit for Non-Contact Cooling Water (Permit No. MA250000). General permit coverage is being requested for two existing permitted intake and outfall structures, designated 002 and 003, located along the Charles River in Cambridge, Massachusetts. An intake and outfall location map is attached as Figure 1. Figure 2 shows the intake and outfall locations on an aerial photograph of the site and surrounding area.

1.0 Background

Authorization to discharge non-contact cooling water was granted to MIT in 1974 under NPDES Permit No. MA0000795. The permit covered four outfalls, designated 001, 002, 003, and 004. Timely renewal was submitted in 1979 and requests to modify the permit were submitted in 1990 and 1992.

Outfalls 001 and 004 are no longer used for the discharge of once through cooling water by MIT and there are no plans to use these outfalls for non-contact cooling water at this time. Outfall 002 addressed non-contact cooling water for equipment associated with the Magnet Laboratory and for air conditioning. It is currently active and will continue to be operated on an intermittent basis for equipment cooling. Outfall 003 was primarily used for power plant non-contact cooling, but was also used for equipment cooling and the discharge of storm water. The historical cooling water uses at this outfall have been discontinued, but MIT is investigating the feasibility of reactivating this structure to support engine research efforts directed at improving fuel economy and operating efficiency.

MIT's current NPDES permit authorizes the discharge of up to 6.0 million gallons per day (mgd) of non-contact cooling water through Outfall 002 and up to 6.72 mgd from Outfall 003. Other terms and conditions of the permit applicable to Outfalls 002 and 003 include:

- The maximum daily discharge temperature cannot exceed 83^{o}F;
- The discharge cannot raise the receiving water temperature by more than 4^{o}F;
- The pH of the discharge must be greater than or equal to 6.0 standard units (S.U.) and less than or equal to 8.3 S.U.

Current non-contact cooling water requirements for Outfall 002, totaling up to 0.18 mgd, are significantly less than under the existing NPDES permit. Therefore, MIT is requesting that the maximum daily flow for Outfall 002 be reduced from 6.0 mgd to 0.18 mgd. Projected future non-contact cooling water requirements for Outfall 003 are projected to total 0.5 mgd to support engine research activities. Therefore, MIT is requesting that the maximum daily flow for Outfall 003 be reduced from 6.72 mgd to 0.5 mgd. With these revisions coupled with deactivation of Outfalls 001 and 004, the total non-contact cooling water requirements for the Facility will be less than 0.7 mgd.

Physical and operational characteristics for Outfalls 002 and 003 are described below:

1.1 Intake and Outfall 002

Intake and Outfall 002 were constructed in the early 1960's to support equipment cooling and air conditioning operations at the Francis Bitter National Magnet Laboratory (Building NW14) located at 150 Albany Street in Cambridge, MA. The intake and outfall structures were originally designed to withdraw and return up to 5,500 gpm (up to 7.9 mgd) of river water for cooling purposes. As indicated above, under the existing NPDES permit, MIT is authorized to discharge up to 6.0 mgd of non-contact cooling water from this outfall.

As shown in Figures 1 and 2, Outfall 002 is located near the intersection of Memorial Drive and Endicott Street, approximately 1100 feet upstream of the Harvard Bridge. The outfall consists of a 30-inch diameter concrete pipe installed at an invert elevation of 7.5 feet. The normal high water elevation at the discharge point is approximately 14 feet and the normal low water elevation is approximately 12.5 feet. Average water depth at the outfall is estimated to range between 8.5 feet and 10 feet. The discharge pipe is positioned flush with the existing granite seawall and is not visible from the shoreline or river.

The intake opening is located approximately 190 feet downstream of the outfall. It consists of rectangular opening installed flush with the seawall. The intake opening is 7 feet wide by 4 feet tall and is equipped with a trash rack. The invert for the opening is approximately 6 feet below the mean water level of the river. It is not visible from the shoreline or river.

Location coordinates for Intake and Outfall 002 are listed below:

	Latitude	Longitude
Intake 002	42^{o} 21' 21.15" N	71^{o} 05' 44.20" W
Outfall 002	42^{o} 21' 20.37" N	71^{o} 05' 46.46" W

After entering a river water sump, located adjacent to the river, non-contact cooling water travels through a 48-inch diameter intake pipeline. The intake pipeline is used to convey cooling water approximately 1400 feet to an intake sump located in Building NW15 (See Attachment B, Sheet SS2). The intake sump contains a 125 gallon per minute (gpm) non-contact cooling water pump and basket strainer. The pump is used to supply non-contact cooling water to support plasma research efforts conducted in Building NW21. Specifically, non-contact cooling water is required for the intermittent operation of a high voltage alternator.

After passing through the alternator, non-contact cooling water is returned to a discharge sump located in Building NW15 adjacent to the intake sump. The discharge pipeline, used to return non-contact cooling water to the river, runs parallel to the intake pipeline and is also 48-inches in diameter. Because of its installed depth, the discharge pipeline is fully submerged at all times.

1.2 Frequency of Operation for Intake and Outfall 002

Based on past operating experience, the alternator is operated for up to 26 weeks per year. When in use, it is operated for 10 to 12 hours per day, generally 4 days per week. MIT anticipates that the frequency of alternator operation in the future will be similar to past operating practice. Projected non-contact cooling water requirements are summarized below:

Projected Frequency of Operation	**Flow Rate (gpm)**	**Hours of Operation**	**Discharge Volume Million Gallons**
Maximum Day*	125	24*	0.18*
Average Day	125	12	0.09
Typical Week	125	48 (12 hours/day, 4 days per week)	0.36
Maximum Week	125	60 (12 hours/day/5 days per week)	0.45
Maximum Month	125	240 (12 hours/day, 20 days/month)	1.8
Average Annual	125	1248 (12 hours/day, 4 days per week, 26 weeks/year)	9.36

* Note that the intake pump has only operated 24 hours per day on two occasions, both of which were to protect the equipment from freezing temperatures during the winter when the alternator was offline.

1.3 Intake and Outfall 003

As indicated above, MIT is evaluating the efficacy of reactivating Intake and Outfall 003 to support research efforts in Building 31 directed at improving engine fuel economy and operating efficiency. The non-contact cooling water flow for this system would total 0.5 mgd maximum and will be designed to meet the terms and conditions outlined in the general permit. MIT anticipates that operating characteristics for this system will be available by January, 2009. NPDES permit coverage for reactivation of Intake and Outfall 003 is requested under the Massachusetts General Permit for Non-contact Cooling Water assuming that the discharge would comply with all applicable permit terms and conditions.

Intake and Outfall 003 were originally constructed in 1915. They were initially used to provide non-contact cooling water to MIT's main power plant and the mechanical engineering steam laboratory. As cooling water requirements for on-campus power generation declined, they were subsequently used for air conditioning at the Materials Laboratory, and for equipment cooling in several research laboratories. Over the past five years, the intake and outfall have not been used to supply non-contact cooling water to the Facility. Nevertheless, routine inspection and maintenance has been provided to ensure that the physical components of the intake and discharge structures were properly maintained. The intake and outfall piping system for Outfall 003 also picks up some storm water piping and roof drainage from the MIT main campus area.

Outfall 003 is located approximately 400 feet downstream of the Harvard Bridge, across from 222 Memorial Drive, in Cambridge, Massachusetts (See Figures 1 and 2). The outfall consists of a 30-inch diameter concrete pipe at an invert elevation of 8.17 feet. The normal high water elevation at the discharge point is approximately 14 feet and the normal low water elevation is approximately 12.5 feet. Average water depth at the outfall is estimated to range between 8.5 feet and 10 feet. The discharge pipe is nearly flush with the existing granite seawall and is not visible from the shoreline or river.

The intake opening is located approximately 50 feet upstream of the outfall. It consists of a 30-inch diameter concrete pipe installed flush with the seawall. The invert for the opening is approximately 5 feet below the mean water level of the river. As such, the intake opening is not visible from the shoreline or river. The intake pipeline consists of a 30-inch diameter concrete pipe, which conveys non-contact cooling water approximately 260 feet to an intake screen well (See Attachment B, Sheet SS3).

The intake screen well, installed in 1963, is equipped with a conventional vertical traveling screen manufactured by the Link-Belt Division of FMC Corporation. The screen well has a depth of 9 feet, with a low water operating level of 5 feet at the design intake flow rate of 14,900 gallons per minute (gpm) or 21 mgd. The screen baskets are 7 feet wide and equipped with standard 3/8-inch square mesh openings. A ¾ horse-power motor is used to rotate the screens at 12 feet per minute. The screens are cleaned using a spray wash system designed to deliver from 170 to 195 gpm of water at a pressure ranging between 60 and 80 psi. Screen wash water is returned to the river through Outfall 003.

The intake sump for Intake 003 is located in Building 31 (See Attachment B, Sheet SS3). Both the intake and return lines extending from the screen well to the intake sump are 24-inches in diameter.

Location coordinates for Intake and Outfall 003 are listed below:

	Latitude	Longitude
Intake 003	42^{o} 21’ 26.51” N	71^{o} 05’ 28.72” W
Outfall 003	42^{o} 21’ 26.70” N	71^{o} 05’ 28.16” W

1.4 Frequency of Operation for Intake and Outfall 003

Operating characteristics for Intake and Outfall 003 are currently being investigated. Design details for the potential reactivation of these structures is anticipated to be available by January, 2009. . Projected non-contact cooling water requirements are summarized below:

Projected Frequency of Operation	Flow Rate (gpm)	Hours of Operation	Discharge Volume Million Gallons
Maximum Day	350	24	0.5
Average Day	350	TBD*	TBD
Typical Week	350	TBD	TBD
Maximum Week	350	TBD	TBD
Maximum Month	350	TBD	TBD
Average Annual	350	TBD	TBD

* TBD: To Be Determined

2.0 Lower Charles River Flow Statistics

The nearest long term USGS gaging station to the site is located along the Charles River at Waltham, MA. The drainage area to the USGS Station at Waltham (Station No. 01104500) is 227 square miles, exclusive of 23.6 square miles of Stony Brook from which flow is diverted for municipal water supply purposes by the City of Cambridge. The drainage area to the Watertown Dam, which represents the upper end of the lower Charles River, is approximately 281 square miles. To account for the additional watershed drainage between the USGS gage at Waltham and the starting point of the lower Charles River at the Watertown Dam, 24% must be added to any flow recorded at Waltham (USGS, 2002). The average annual discharge at Waltham, over the period 1932 through 1999, was 310 cfs. Adjusting this to account for the increased drainage area to the Watertown Dam, the average annual flow of the lower Charles River at the Watertown Dam is 384 cfs. Although the site is located downstream of the Watertown Dam, flow statistics at the Watertown Dam are reasonably representative of flow past the site.

Average monthly flow at Waltham and the Watertown Dam over the period 1938 through 1999 is graphically shown in Figure 3. The 7-day, 10-year low flow (7Q10) was determined through application of EPA’s DFLOW3 program. The 7Q10 flow for the USGS gage at Waltham over the period 1960 through 2004 is 17.2 cfs. Applying the 24% correction factor to account for the additional drainage area at the Watertown Dam, the 7Q10 flow for the lower Charles River at the Watertown Dam is estimated to be 21.3 cfs.

2.1 Massachusetts Water Quality Criteria for the lower Charles River

Massachusetts has classified the waters of the lower Charles River as a Class B (314 CMR 4.00) warm water fishery. Class B waters are designated as a habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. Where designated, they shall be suitable as a source of public water supply with appropriate treatment. They shall also be suitable for irrigation and other agricultural uses and for compatible industrial cooling and process uses. In addition, these waters shall have consistently good aesthetic value. General water quality criteria applicable to Class B waters, including those applicable to the Charles as a warm water fishery, are summarized below:

1) **Dissolved Oxygen**

a. Shall not be less than 5.0 mg/l in warm water fisheries unless background conditions are lower.
b. Natural seasonal and daily variations above this level shall be maintained; levels shall not be lowered below 60% of saturation in warm water fisheries due to a discharge; and
c. Site-specific criteria may apply where background conditions are lower than specified levels, to the hypolimnion of stratified lakes or where the Department determines that designated uses are not impaired.

2) **Temperature**

a. Shall not exceed 83^{o}F (28.3^{o}C) in warm water fisheries, and the rise in temperature due to a discharge shall not exceed 5^{o}F (2.8^{o}C) in rivers and streams designated as warm water fisheries (based on the minimum expected flow for the month); in lakes and ponds the rise shall not exceed 3^{o}F (1.7^{o}C) in the epilimnion (based on the monthly average of maximum daily temperature; and
b. Natural seasonal and daily variations shall be maintained. There shall be no changes from background conditions that would impair any use assigned to the Class, including site-specific limits necessary to protect normal species diversity, successful migration, reproductive functions or growth of aquatic organisms.

3) **pH**

Shall be in the range 6.5 through 8.3 standard units and not more than 0.5 standard units outside of the normally occurring range. There shall be no change from background conditions that would impair any use assigned to this Class.

4) **Fecal Coliform Bacteria**

Shall not exceed a geometric mean of 200 organisms per 100 ml in any representative set of samples nor shall more than 10% of the samples exceed 400 organisms per 100 ml. This criterion may be applied on a seasonal basis at the discretion of the Department.

5) **Solids**

These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.

6) **Color and Turbidity**

These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this Class.

7) **Oil and Grease**

These waters shall be free from oil, grease and petrochemicals that produce a visible film on the surface of the water, impart an oily taste to the water or an oily or other undesirable taste to the edible portions of aquatic life, coat the banks or bottom of the water course, or are deleterious or become toxic to aquatic life.

8) **Taste and Odor**

None in such concentrations or combinations that are aesthetically objectionable, that would impair any use assigned to this Class, or that would cause tainting or undesirable flavors in the edible portions of aquatic life.

During dry weather, the Lower Charles generally meets water quality standards. But during and after storms, the river often fails to meet boating and swimming standards for fecal coliform bacteria. Following rainstorms, the water quality of the river may become impaired.

According to the USGS, the poor quality of the storm water and its relatively large quantity, delivered to the river over a short period of time due to the impervious nature of the landscape, together with untreated sewage from combined sewer overflow (CSO) discharges, result in large contaminant loads that appear to exceed the river's assimilative capacity, primarily with respect to fecal coliform bacteria. Sediment contaminants may also be re-entrained into the water column under certain hydrological conditions, further impairing water quality. Because of these factors, DEP has designated the waters of the lower basin as impaired due to organic enrichment/low dissolved oxygen (DO), noxious aquatic plants, and taste, odor and color problems, along with, contaminated sediments, harmful bacteria, and increased turbidity.

In January 2007, DEP published a final pathogen total maximum daily load (TMDL) report to address pathogens entering the Charles River Watershed. Certain bacteria, such as coliform, *E. coli*, and enterococcus bacteria, are indicators of contamination from sewage and/or the feces of warm-blooded wildlife (mammals and birds). Such contamination may pose a risk to human health. Therefore, in order to prevent further degradation in water quality and to ensure that waterbodies within the watershed meet state water quality standards, the TMDL establishes indicator bacteria limits and outlines corrective actions to achieve that goal.

In October 2007, EPA and the Massachusetts Dept. of Environmental Protection (MassDEP) announced aggressive targets to reduce harmful levels of the nutrient phosphorus from entering the Charles River through storm water. The effort to reduce phosphorus was begun on October 19, 2007 with EPA's approval of a "Total Maximum Daily Load" for discharges of phosphorus into the lower Charles River. A TMDL determines how much of a pollutant can be put into a body of water before it has harmful effects. EPA and MassDEP developed and approved the new limits on phosphorus to the lower Charles using extensive data collected in the river. EPA's goal is to reduce phosphorus discharges to the lower Charles by 54 percent to restore the river to a healthy state.

3.0 Biological Resource Identification

The Charles River watershed supports a varied fish community of about 20 resident and migratory species. Habitat conditions for fish and other aquatic species have improved in many parts of the river system in recent years. A list of priority finfish species of concern for the lower Charles River was previously developed through consultation with the USEPA, Massachusetts Division of Fisheries and Wildlife, Massachusetts Division of Marine Fisheries, and the National Marine Fisheries Service as part of the Kendall Station Upgrade Project (See Table 1). The list is premised on the occurrence/importance of these species in the lower Charles River Basin.

Table 1: Lower Charles River List of Finfish Priority Species	
Common Name	**Scientific Name**
River Herring (Alewife & Blueback Herring)	*Alosa psuedoharengus* and *A. aestivalus*
White Perch	*Morone Americana*
Sunfish (Pumpkinseed & Bluegill)	*Lepomis gibbosus* and *L. macrochirus*
Yellow Perch	*Perca flavescens*
American Shad	*Alosa sapidissima*
Black Crappie	*Pomoxis nigromaculatus*
Brown Bullhead	*Ictalurus nebulosus*
Chain Pickerel	*Esox niger*
Channel Catfish	*Ictalurus punctatus*
Common Carp	*Cyprinus carpio*
Golden Shiner	*Notemigous crysoleucas*
Largemouth Bass	*Micropterus salmoides*
Northern Pike	*Esox lucius*
Rainbow Smelt	*Osmerus mordax*
Spottail Shiner	*Notropis hudsonius*
Striped Bass	*Morone saxatilis*
White Catfish	*Ictalurus catus*
American Eel	*Anguilla rostrata*

Life history data and information for the species listed in Table 1 are included in Attachment C.

3.1 Aquatic Resource Characterization

An extensive database is available to characterize the biological resources of the lower Charles River within the administrative record for the Kendall Station Upgrade Project. This includes data and information assembled through ichthyoplankton, beach seine, push net and gill net sampling programs. Intensive sampling programs were initiated in the spring of 1999 and have continued through the summer 2008. Biological sampling stations currently active within the lower Charles River are mapped in Attachment D.

Ichthyoplankton sampling shows that river herring eggs and larvae (Alwife and blueback herring combined) typically represent from 75 to 90 percent of the larval population collected within the lower basin. Further, that the larval season typically extends from mid-May to mid-July. White perch represent an additional 5 to 20 percent of the larval population followed by sunfish, which generally represent less than 5 percent of the larval population.

Gill net collections produced fish representing 17 species. The most abundant species typically include white perch, yellow perch and herring. Two species, blueback herring and yellow perch, generally dominate the catch (i.e., roughly 75%) on a year to year basis. The next largest group consisted of white perch, alewife, common carp, and golden shiner, and make up about 20% of the catch. Remaining species typically represent 5% of the catch.

Yellow perch abundance has declined in the lower Charles River since 1999. This observation correlates with increasing bottom salinity conditions. They have been documented in Maryland estuaries to decline when salinities greater than 12 ppt persist (Maryland DNR, 2005). White perch, which depend on low salinity waters for reproductive success, also declined in abundance from 2002 to 2006. Pumpkinseed sunfish, which are benthic invertebrate “feeders,” have also declined throughout the lower basin. Pumpkinseed have declined while the closely related bluegill, an opportunistic feeder, has not.

White perch, which also depend on low salinity waters for reproductive success, declined steadily in abundance from 2002 to 2006. Smith (1971) cited in Hardy (1978) reported a maximum salinity of 4.2 ppt for spawning. Bath and O'Connor (1985) cited in Collette and MacPhee (2002) reported that immature white perch eat planktonic organisms - cladocera, fish eggs (including alewife), and fish larvae. Adults are more likely to focus on benthic prey - amphipods, isopods, insects, annelid worms, and shrimp. These characteristics indicate that declining numbers of white perch in the seine collections since 2004 may be attributable to persistent high benthic salinity.

3.2 Bentos Sampling

Benthic sampling programs were conducted in 2000, 2006 and 2007. Benthic populations at shallow stations sampled in 2007 (Magazine, Hyatt, Boston, and Shallow Diffuser) had higher diversity and overall abundance compared to the deep stations (Deep Diffuser and MIT). A similar pattern was observed in 2000 and 2006. In general, benthic organisms collected in the Charles River are typical of those found in stressful conditions that at times include low dissolved oxygen and a wide range in salinity.

The disparity in benthic abundance and diversity between shallow and deep stations is due to the differences in water quality and bottom sediments within the lower Basin. Unimpeded estuaries experience tidal mixing with each tidal cycle, introducing oxygenated water. In the Charles River, operation of the locks and trapping of water behind the dam inhibits this mixing, resulting in stagnant pools of high salinity and low dissolved oxygen conditions at depth. These pools have persisted in recent years.

3.3 Attributes of Intake 002

Intake 002 consists of rectangular opening installed flush with the seawall. The intake opening is 7 feet wide by 4 feet tall and is equipped with a trash rack. The invert for the opening is approximately 6 feet below the mean water level of the river.

Water entering the opening is directed to a river water sump adjacent to the seawall. It then flows through a 48-inch diameter intake pipeline approximately 1400 feet in length to the intake sump. The intake sump contains a 125 gpm non-contact cooling water pump and basket strainer.

3.3.1 Design Measures for Intake 002

Based on an intake withdrawal rate of 125 gpm, the approach velocity to the intake opening is 0.010 feet per second (fps). Applying a 10% adjustment factor to account for the space occupied by the trash rack, the through rack velocity would be 0.011 fps. The length of the intake pipeline between the river water sump and the intake sump is approximately 1400 feet. Because the pipeline operates in a flow full condition, the average velocity through the 48-inch diameter intake pipeline is 0.022 fps. For comparison, the current EPA guidance value for through screen or through technology velocity for intake structures is 0.50 fps.

3.3.2 Operational Measures for Intake 002

The volume of the intake pipeline between the river water sump and the intake sump is approximately 17,584 cubic feet or 131,500 gallons. Noting that the non-contact cooling water pump is typically operated for only 12 hours per day, the daily volume of water pumped is 90,000 gallons. Based on this, the residence time of intake water within the intake pipeline is greater than 24 hours. Because corresponding flow velocity is only 0.022 fps, the potential for impingement of aquatic organisms is negligible.

Primary measures used to reduce entrainment are directed at volume reduction. The alternator is equipped with a temperature controlled cooling valve. The temperature control valve automatically adjusts the cooling water flow rate though the cooling water jacket to satisfy cooling needs. This reduces the cooling water volume required during start up and shut down activities. When the alternator is shut down, the cooling water pump is also turned off.

In addition, biocides are not required or used at any point within the non-contact cooling water system.

3.3.3 Historical Occurrence of Impinged Fish

Although formal sampling for impingement has not been performed, fish have not been found during routine maintenance and cleanout of the basket strainer at the intake sump.

3.3.4 Cooling Water Discharge Characteristics

The discharge of non-contact cooling water through Outfall 002 is expected to comply with the terms and conditions of the Massachusetts Non-contact Cooling Water General Permit. The maximum discharge temperature at the outfall is not expected to exceed 83^{o}F at any time and the river temperature is not expected to increase by more than 5^{o}F at any time.

Although ambient water temperature in the river can approach 83^{o}F, the water temperature at the intake sump has not exceeded 80^{o}F under summer operating conditions. This is likely attributable to cooling associated with the extended residence time of water as it passes through the intake pipeline. As noted above, under typical operating conditions the residence time in the intake pipeline exceeds 24 hours.

The normal temperature rise through the alternator under peak operating conditions ranges between 5^{o}F and 7^{o}F. Assuming an intake sump temperature of 80^{o}F, the discharge temperature from the cooling water jacket would range from 85^{o}F to 87^{o}F. However, the residence time in the 48-inch diameter discharge pipeline (in excess of 24 hours under normal operating conditions) is sufficient to reduce the temperature at the outfall to less than 83^{o}F. To confirm that the discharge temperature at the outfall remains below 83^{o}F, a monitoring point will be established at a manhole located approximately 10 feet upstream of the outfall.

In accordance with Attachment B of the General Permit, the following equation is used to calculate the dilution factor at the outfall:

$$\text{Dilution Factor} = \frac{QR + (QP \times 1.55)}{QP \times 1.55}$$

where:

QR= 7Q10 low flow for the receiving water at the plant’s outfall, in cubic feet per second (cfs) = 21.3 cfs

QP = Plant's maximum design flow, in million gallons per day (mgd) = 0.18 mgd.

1.55 = Factor to convert mgd to cfs.

By substitution, the dilution factor for Outfall 002 is:

$$\text{Dilution Factor} = \frac{21.3\text{ cfs} + (0.18\text{ mgd} \times 1.55)}{(0.18\text{ mgd} \times 1.55)}$$

Dilution Factor = 77.3

The largest projected temperature difference between the river and the outfall is expected to occur during winter operating conditions. Under winter operating conditions, it is reasonable to assume that river water temperature will average 35^{o}F. If the alternator has been shut down for a period of time, water resident in the intake and discharge pipeline will likely approach 55^{o}F, the average groundwater temperature in Massachusetts. Following startup, 55^{o}F water will be displaced by the discharge and enter the river through the outfall. This will result in a potential temperature difference of 20^{o}F.

Using the methodology outlined in Attachment 1 of the General Permit, the maximum change in river water temperature would be:

$$\text{Delta } T_{river} = (QP \times 1.55)/QR \times \text{Delta } T_{plant}$$

$$\text{Delta } T_{river} = (0.18 \times 1.55)/21.3 \times 20^oF$$

$$\text{Delta } T_{river} = 0.26^oF$$

3.4 Attributes of Intake 003

The intake opening is located approximately 50 feet upstream of the outfall. It consists of a 30-inch diameter concrete pipe installed flush with the seawall. The invert for the opening is approximately 5 feet below the mean water level of the river. The intake pipeline consists of a 30-inch diameter concrete pipe, which conveys non-contact cooling water approximately 260 feet to the intake screen well.

The intake screen well is equipped with a conventional vertical traveling screen. The screen well has a depth of 9 feet, with a low water operating level of 5 feet at an original design intake flow rate of 14,900 gallons per minute (gpm) or 21 mgd. The screen baskets are 7 feet wide and equipped with standard 3/8-inch square mesh openings. A ¾ horse-power motor is used to rotate the screens at 12 feet per minute. The screens are cleaned using a spray wash system designed to deliver from 170 to 195 gpm of water at a pressure ranging between 60 and 80 psi. Screen wash water is returned to the river through Outfall 003.
.

3.4.1 Design Measures for Intake 003

Based on an intake withdrawal rate of 350 gpm, the approach velocity to the intake opening and the flow through velocity of the intake pipeline will be 0.16 fps. The approach velocity to the intake screen is 0.03 fps. Applying a 40% adjustment factor to account for the space occupied by the screen mesh and baskets (i.e., assuming 60% open area), the through screen velocity would be 0.05 fps. For comparison, the current EPA guidance value for through screen or through technology velocity for intake structures is 0.50 fps.

3.4.2 Operational Measures for Intake 003

The frequency of operation for Intake 003 is currently being evaluated. However, given the very low through screen velocity of 0.05 fps and a volumetric withdrawal rate limited to 0.5 mgd, the potential for impingement of aquatic life on the screen is negligible.

In accordance with the terms and conditions of the general permit, biocides will not be used at any point within the non-contact cooling water system.

3.4.3 Historical Occurrence of Impingement

Intake 003 has not been in operation over the past 5 years and no historic database is available for review. Nevertheless, if the intake is reactivated at a withdrawal rate of 0.5 mgd, the potential for impingement of aquatic life is considered negligible.

3.4.4 Cooling Water Discharge Characteristics

The discharge of non-contact cooling water through Outfall 003 will be designed to comply with the terms and conditions of the Massachusetts General Permit for Non-contact Cooling Water. The maximum discharge temperature at the outfall is not expected to exceed 83^{o}F at any time and the river temperature is not expected to increase by more than 5^{o}F at any time.

In accordance with Attachment B of the General Permit, the available dilution factor at the outfall is:

$$\text{Dilution Factor} = \frac{QR + (QP \times 1.55)}{QP \times 1.55}$$

where:

QR= Estimated 7Q10 low flow for the receiving water at the plant’s outfall, in cubic feet per second (cfs) = 21.3 cfs

QP = Plant's maximum design flow, in million gallons per day (mgd) = 0.5 mgd.

1.55 = Factor to convert mgd to cfs.

By substitution, the dilution factor for Outfall 003 is:

$$\text{Dilution Factor} = \frac{21.3 \text{ cfs} + (0.5 \text{ mgd} \times 1.55)}{(0.5 \text{ mgd} \times 1.55)}$$

$$\text{Dilution Factor} = 28.48$$

Data and information relative to projected heat load characteristics for Outfall 003 will be available by January 2009.

4.0 Threatened or Endangered Species

Appendix 2 of the General Permit indicates that there are four listed species of concern to facilities seeking permit coverage, namely the shortnose sturgeon, the dwarf wedge mussel, the bog turtle, and the northern redbelly cooter. The shortnose sturgeon is listed under the jurisdiction of NOAA Fisheries and the dwarf wedge mussel, the bog turtle, and the northern redbelly cooter are listed under the jurisdiction of the U.S. Fish and Wildlife Service. None of the above species are believed to be present within the lower Charles River Basin. Therefore, no adverse impacts to these species are anticipated.

Informal consultation has been initiated with the US Fish and Wildlife Service (US FWS), Massachusetts Natural Heritage and Endangered Species Program and the National Marine Fisheries Service (NMFS) (See Attachment E). Copies of agency correspondence will be forwarded to EPA and Ma DEP upon receipt.

5.0 National Historic Preservation Act

Facilities seeking coverage under the NCCW General Permit must not adversely affect properties listed or eligible for listing in the National Registry of Historic Places under the National Historic Preservation Act of 1966. In addition, facilities must comply with applicable State, Tribal and local laws concerning the protection of historic properties and places and facilities seeking coverage are required to coordinate with the State Historic Preservation Officer and/or Tribal Historic Preservation Officer and others regarding effects of their discharges on historic properties.

Because the NOI requests a reduction in current permitted flows through existing structures, the structures are not visible from the shoreline or river, and no new construction activity is envisioned, potential impacts to historic properties are not anticipated. The Massachusetts Historical Commission has been contacted to solicit input relative to the NOI (See Attachment E). Copies of agency correspondence will be forwarded to EPA and MA DEP upon receipt.

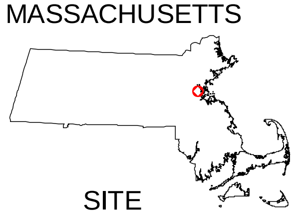
N

0 100 200
Feet

Base map: 2005 Orthophoto, MASSGIS

C:\WorkSpace\waiting_onSchaf.mxd

MASSACHUSETTS



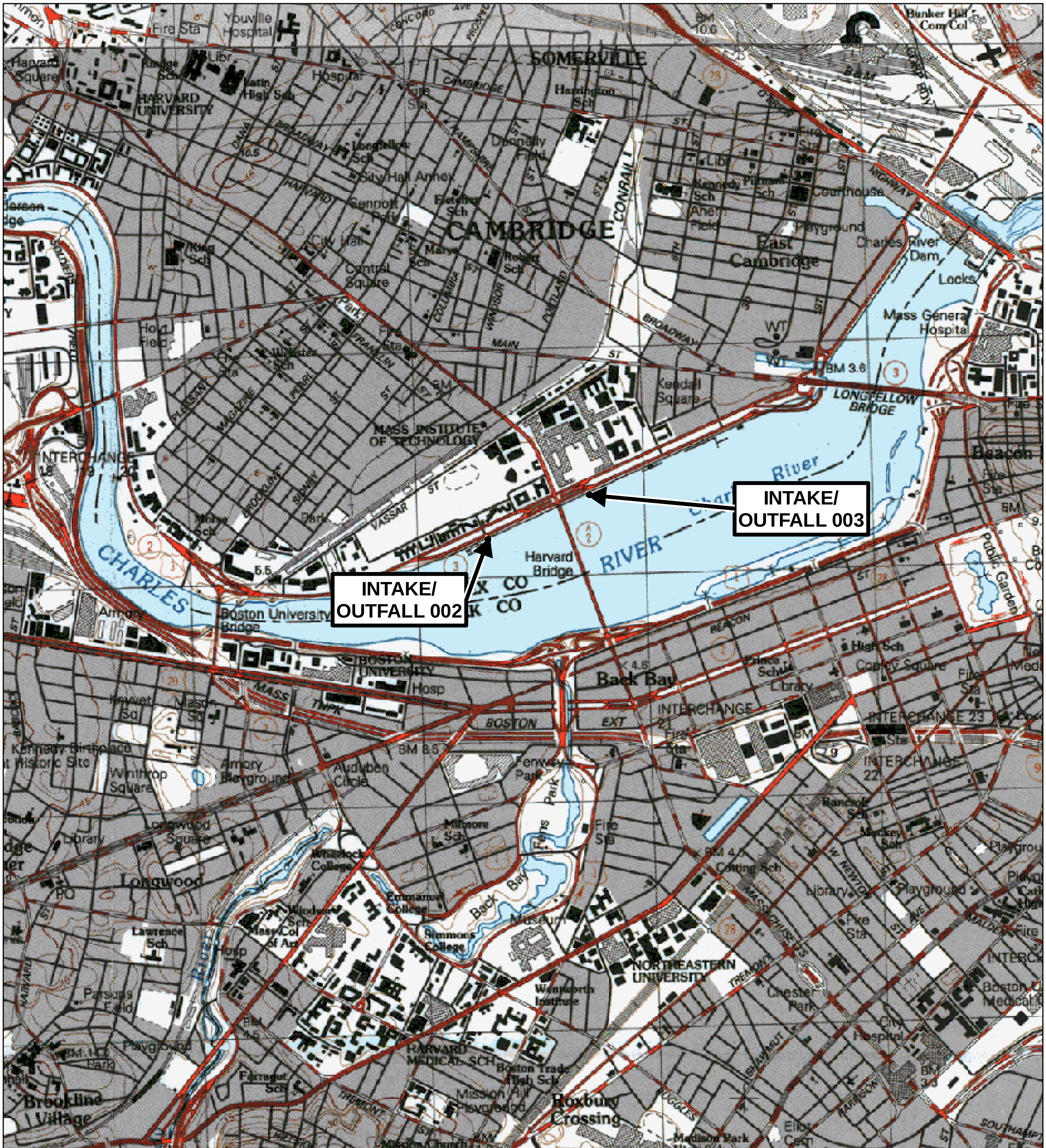
SITE
LOCATION

TRC
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
978-970-5600

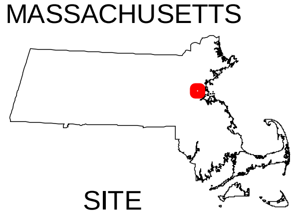
AERIAL PHOTO

MASSACHUSETTS INSTITUTE OF TECHNOLOGY INTAKE / OUTFALL LOCATIONS

FIGURE 2	September 2008



MASSACHUSETTS



SITE
LOCATION

Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
978-970-5600

SITE LOCATION MAP

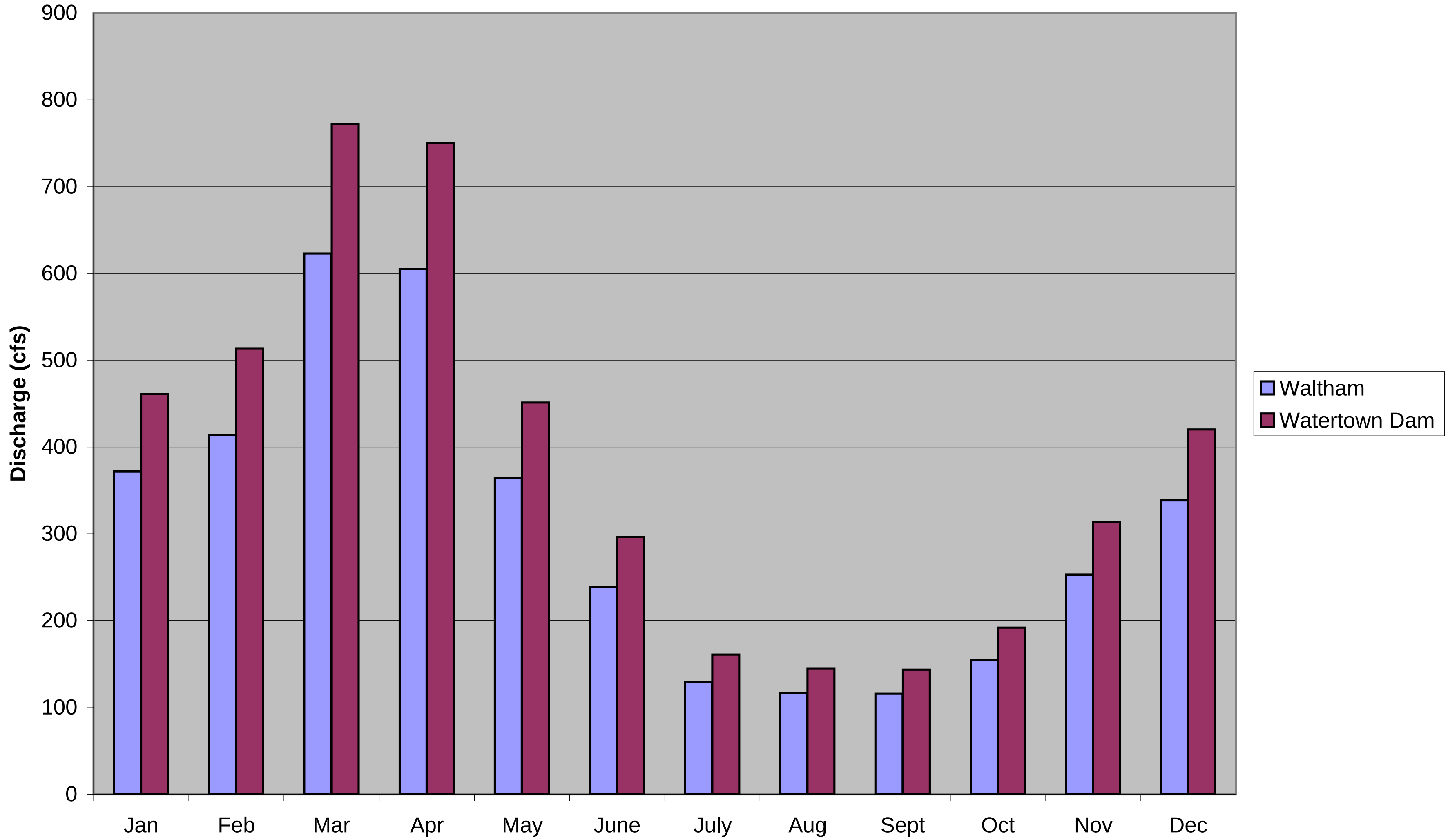
MASSACHUSETTS INSTITUTE OF TECHNOLOGY INTAKE / OUTFALL LOCATIONS

FIGURE 1	September 2008

Base map: USGS 7.5 Minute Topographic Quadrangle Boston North and Boston South

C:\WorkSpace\waiting_onSchaf_again.mxd

Figure 3
Average Monthly Flow - Charles River



ATTACHMENT B

Site Layout Drawings

MIT Department of FACILITIES

77 Massachusetts Avenue, Cambridge, MA 02139

FILE_ID : 00F$

Campus Utility Distribution

REVISIONS

NO.	DESCRIPTION	DATE
10	BLDG NE47, 6"SS	03.28.04
11	PERMIT SAMPLE LOCATIONS	04.07.04
12	GENERAL REVISIONS	07.16.04
13	GENERAL REVISIONS	08.12.05
14	BLDGS 32, 46	12.12.05
15	CAMPUS BASEMAP UPDATE	11.02.06

PROJECT No.	:	
DATE	:	3.16.01
DRAWN	:	I.Arestova
CHECKED	:	
SCALE	:	1"=100'-0"

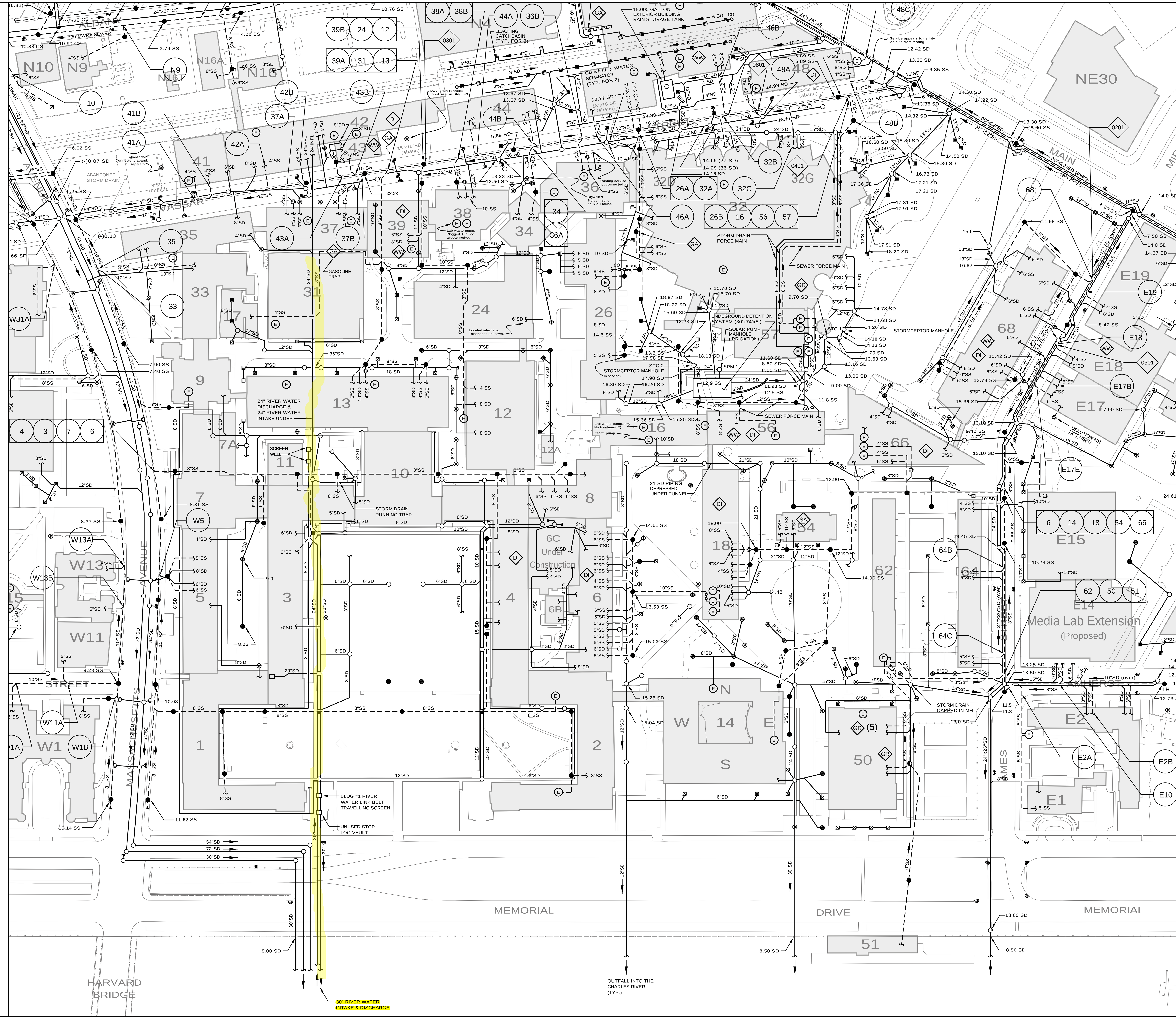
NORTH

MA-NAD27

Storm & Sanitary
West Campus

SS2

SHEET 2 of 6



MIT Department of FACILITIES

77 Massachusetts Avenue, Cambridge, MA 02139

Campus Utility Distribution

REVISIONS

NO.	DESCRIPTION	DATE
10	BLDG NE47, 6"SS	03.28.04
11	PERMIT SAMPLE LOCATIONS	04.07.04
12	GENERAL REVISIONS	07.16.04
13	GENERAL REVISIONS	08.12.05
14	BLDGS 32, 46	12.12.05
15	CAMPUS BASEMAP UPDATE	11.02.06

PROJECT No.	:	
DATE	:	3.16.01
DRAWN	:	I.Arestova
CHECKED	:	
SCALE	:	1"=100'-0"

NORTH

MA-NAD27

Storm & Sanitary
Main Campus

SS3

SHEET 3 of 6

ATTACHMENT C

Aquatic Fishery - Life History Information

Attachment C
Life History Data and Information for Fish Species of the Lower Charles River

Morone americana (white perch)

Although many ichthyologists generally place the temperate basses of the family Moronidae, striped bass) with the percicthyids, white perch differ from the striped bass in general body morphology and possess deeper bodies, are more laterally compressed, and have no stripes. The dorsal profile is highly arched while the ventral profile is evenly curved (Smith, 1985). The dorsal fins are connected by a low, but definite, membrane (Smith, 1985). The caudal fin is moderately forked, with bluntly pointed lobes (Smith, 1985). The dorsal surface is dark grey or olive, sometimes brownish, shading to silvery on the sides and white on the underside (Smith, 1985).

Although white perch can tolerate temperature ranges of 2 – 32.5 °C (35.6-90.5 °F), and which varies with location, season, and acclimation temperature, it has been reported that some mortality may occur if the water temperature attains 27 °C (80.6 °F) for several days (Fish & Wildlife Information Exchange/VA Tech, 2000). White perch adults tolerate a pH range from 6.0-9.0 in freshwater and turbidity has little effect on any lifestage (Fish & Wildlife Information Exchange/VA Tech, 2000).

Eggs

After spawning, adults move downstream. Estimates of white perch fecundity range from 20,000 to 321,000 eggs per female, which as one could assume, varies with the age and size of the female. Fertilized white perch egg masses sink to the bottom, are extremely adhesive, and are quite small. Egg diameter at the time of hatching measures 1.58 mm.

Larvae/Juveniles

Newly hatched larvae (yolk sac larvae) range from approximately 1.58 to 3.17 mm in length and are exclusively demersal. The transition from the yolk sac larvae to preflexion larvae, which is marked by the complete absorption of the yolk sac, occurs at a length of 3.17 mm. Transformation larvae, i.e. Stage between postflexion larvae and juveniles, measure 25.4 mm in length.

Micropterus salmoides (largemouth bass)

Compared to other members of the sunfish family, the largemouth bass is an elongate, robust species. The largemouth bass has a larger mouth, with the maxillary falling below or beyond the rear margin of the eye (Smith, 1985). The largemouth bass also possesses a deeply notched dorsal fin, larger scales, and bifurcate pyloric caeca (Smith, 1985). It is believed that the function of the pyloric caeca involves both digestion and absorption (Bond, 1996). The dorsal fin is single and deeply notched, the caudal fin is slightly forked, with blunt lobes, the anal fin begins below the second dorsal fin ray, the pelvic fin is inserted below the dorsal origin, and the pectoral fin is asymmetrically rounded (Smith, 1985). The largemouth bass is dark green above, grading to white ventrally with a broad midlateral stripe. The vertical fins are dusky with the rays outlined.

The largemouth bass typically inhabits warm, weedy parts of lakes, ponds and streams. However, in areas lacking aquatic vegetation the largemouth will be located near hard structures such as boulders, pilings, riprap banks, and large woody debris.

<u>Eggs</u>

The largemouth bass spawns in deeper waters (1-4 feet) than the sunfishes (discussed below). Eggs are discharged into a nest in small batches at 30-second intervals (Smith, 1985). Eggs are spherical, adhesive initially, demersal and range in diameter from 1.63-1.71 mm (Wang & Kernehan; in Wang, 1986). The yolk is yellowish and granular, with a single 0.52mm diameter oil globule (Wang & Kernehan, 1979; in Wang, 1986). The chorion is transparent and thin with the perivitelline space ranging from 0.16-0.24 mm in width (Wang & Kernehan, 1979; in Wang, 1986). The nest is closely guarded by the adults.

<u>Larvae/Juveniles</u>

At the time of hatching YSL range in length from 3.6-4.1 mm TL (Wang & Kernehan, 1979; in Wang, 1984) although fishes as small as 2.3mm TL have been recorded (Perche, 1964; in Wand, 1986). Upon complete absorption of the yolk sac, PYSL range in size from 6.5-8.5 mm TL (Wang, 1986). Newly hatched larvae are closely affiliated with the nest and by the time they are PYSL, they venture to the surface and gradually disperse into adjacent submersed macrophyte stands. (By the time largemouth bass reach the juvenile stage, fishes measure approximately 36mm TL (Wang, 1986). Juveniles are closely associated with submersed macrophyte stands near the edges of ponds or those stands that harbor golden shiner larvae (Kramer & Smith; in Wang, 1986).

***Lepomis gibbosus* (pumpkinseed)**

The pumpkinseed is the most abundant and widely distributed species of sunfish (Smith, 1985). It is a short, deep bodied species with a long, pointed pectoral fin and it's opercular flap has a pale margin with a red sector (Smith, 1985). The opercle bone is stiff and not fimbriate (bordering). This species is often taken with the bluegill (see below). The caudal fin of the pumpkinseed is slightly forked and has blunt lobes (Smith, 1985). The pectoral fin is retrogressive, with a blunt anterior corner. The mouth is small, terminal, with the maxillary ending below the front of the eye (Smith, 1985). The head and body of the pumpkinseed is dark green, becoming lighter ventrally (Smith, 1985). The sides have patches of dark scales, some of which are reddish brown. The breast is clear white to yellow, the dorsal fin is dusky mottled with orange markings on the interradial membranes (Smith, 1985).

The pumpkinseed occurs in a wide variety of habitats, from streams and small ponds to the slower parts of rivers.

<u>Eggs</u>

The pumpkinseed builds nests along the shore where water depths range from 6 to 12 inches in depth (Smith, 1985). Oftentimes the nests are situated close to aquatic vegetation. Males begin nesting when the water temperatures reach 65-69 °F (18.15-20.3 °C) (Smith, 1985). Females lay between 600-5,000 eggs depending upon their size and other environmental factors. Specifically, Scott & Crossman (1973; in Wang, 1986) report that Year 2 – Year 5 females deposit between 600-2,900 eggs. The eggs are spherical, adhesive, and demersal and measure approximately 1mm in diameter (Scott & Crossman, 1973; in Wang, 1986). The yolk is pale amber and is granular (Scott & Crossman, 1973; in Wang, 1986). Furthermore, there is one large oil globule surrounded by numerous smaller oil globules, the chorion is thick and transparent (Wang, 1986), and the perivitelline space measures 0.05 mm in width (Balon, 1959; in Wang, 1986).

<u>Larvae/Juveniles</u>

At the time of hatching, pumpkinseed YSL measure 2.4-2.9mm TL (Wang & Kernehan, 1979; in Wang, 1986). Upon complete absorption of the yolk sac, PYSL measure approximately 4.0-5.0 mm TL (Wang, 1986). Newly hatched larvae initially do not exhibit pigmentation but later develop stellate melanophores on the head, dorsal surface of the gut, and sometimes in the postanal regions (Wang, 1986). Larvae are distributed primarily in the shallow weedy waters of creeks, ponds, and reservoirs.

Pumpkinseed juveniles measure approximately 15.1 mm TL (Wang, 1986), can be solitary or form small schools near or among aquatic vegetation and generally avoid moderate to rapid stream flow (Wang, 1986).

***Lepomus macrochirus* (bluegill)**

The bluegill is a deep bodied, highly compressed fish with a long, pointed pectoral fin and a distinct spot on the dorsal fin (Smith, 1985). The opercular flap is well developed but never has a pale margin (Smith, 1985). The spiny part of the dorsal fin is arched with incised membranes while the soft part is rounded (Smith, 1985). The caudal fin is slightly forked, with rounded lobes, the anal fin is rounded (Smith, 1985). The bluegill is greenish olive above and pale below. The vertical fins are dusky with the rays paler than the membranes. The breast is yellowish white (breeding males have a reddish breast). The opercular flap is blue-black and as mentioned above, without a pale margin (Smith, 1985). The bluegill occurs in standing or slow moving water where there is vegetation or other types of shelter (Smith, 1985).

Eggs

The bluegill nests in colonies under 1-3 feet of water on a substrate of firm sand or mud with some debris but little vegetation (Smith, 1985). Spawning occurs from May to June or July when air temperatures are in the upper 70 °F (20.9 °C) (Smith, 1985). Females deposit small egg clusters (or singly) consisting of between 2,500-64,000 eggs (Morgan, 1951; in Wang, 1986). The eggs themselves are spherical, adhesive and demersal and measure between 1.1-1.3 mm in diameter (Wang & Kernehan, 1973; in Wang, 1986). The yolk is pale yellow and granular. Eggs possess a single oil globule approximately 0.3-0.6 mm in diameter (Wang, 1986).

Larvae/ Juveniles

At the time of hatching, bluegill YSL measure 2-3 mm TL (Scott & Crossman, 1973; in Wang, 1986) although ranges of 5-6 mm TL have been reported (Moyle, 1976; in Wang, 1986). The size at completion of the yolk sac larval stage ranges from 4.8-5.0 mm TL (Wang & Kernehan, 1979; in Wang, 1986). Newly hatched larvae remain in the nest area (Wang, 1986), while free- swimming larvae inhabit shallow water with some vegetation (Taber, 1969; in Wang, 1986).

Upon reaching the juvenile stage, bluegills measure 14mm TL (Wang, 1986) and reach lengths of 42mm TL by late in the juvenile stage (Wang, 1986). Juveniles can be found within the limnetic to littoral zones in the sluggish waters of ponds, reservoirs, and pools within creeks (Wang, 1986).

***Alosa aestivalus* (blueback herring)**

The blueback herring is a slender species that most closely resembles the alewife (see below). The body is elongate, with a dorsal profile that is less curved than the ventral profile (Smith, 1985). The dorsal fin is short, it’s margin straight, and it’s corners sharp (Smith, 1985). The anal fin possesses a straight margin and the caudal fin is deeply forked with pointed lobes (Smith, 1985). As the name implies, the blueback herring is blue-gray above, shading to silvery-white on the sides and belly (Smith, 1985). There is a conspicuous dark spot behind the upper end of the gill opening and rows of dark spots along the upper sides of the body (Smith, 1985).

The blueback herring is an anadromous species that moves into larger streams to spawn (Smith, 1985). In a similar manner to other herrings, the blueback is a planktivore whose diet consists mostly of copepods, pelagic shrimp larvae, and larval fishes (Smith, 1985).

Eggs

Within the Hudson River, spawning occurs within the river in tributaries well below the salt front that are characterized by high flow regimes and hard substrates. Blueback herring produce 45,000 to 350,000 eggs per female and which measure approximately 1.0 mm in diameter (Bigelow & Schroeder, 1953). The incubation period takes approximately 50 hours at a water temperature of 72 °F (22.2 °C). In a superficially similar manner to the sturgeons, blueback eggs are demersal and possess adhesive properties, although not to the degree exhibited by sturgeon egg masses. In a recent Hudson River study, peak abundance of herring eggs (combined alewife and blueback) appears to occur in the upper estuary in the Catskill region during mid-late May (DEIS, 1999).

Larvae/Juveniles

At the time of hatching, total larval length (viewed laterally) is 3.17 mm. The transition from the yolk sac larvae to preflexion larvae, which is marked by the complete absorption of the yolk sac, occurs at a length of 4.76 mm. Within a month of hatching, the total length of young bluebacks reaches 12.7 mm.

***Alosa pseudoharengus* (alewife)**

Along with the blueback herring, the alewife is an anadromous member of the Clupeida family. The eggs and larvae of these species are often indistinguishable based upon architecture. However, as these two species age, alewives can be distinguished from blueback herring on the basis of the color of the lining of the body cavity, eye size and external body form. Specifically, the body is compressed and wedge-shaped in cross section (Smith, 1985). The dorsal fin is subdeltoid with a straight margin and sharp corners (Smith, 1985). The color of alewives has been described as grayish green above, with silvery sides (Smith, 1985). There is a small dark spot at the shoulder of adult specimens (Smith, 1985). The peritoneum (membrane lining the coelum)(Bond, 1996) is pale or silvery (Smith, 1985).

The alewife is a schooling fish that lives in open water most of the year and moves into the shallows in the spring to spawn (Smith, 1985). In open water systems, this species exhibits a distinct onshore-offshore movement, moving inshore during the night and moving to deeper waters during the day (Smith, 1985).

Eggs

Spawning occurs within the river in tributaries well below the salt front that are characterized by high flow regimes and hard substrates. Estimates of alewife fecundity include ranges from 2,180-10,011 for Lake Cayuga females to a high median fecundity of 229,000 eggs for females in Connecticut water bodies. In a similar manner to the egg masses of the blueback herring, alewife eggs are semi-demersal and slightly adhesive, but are easily suspended and carried by currents (Smith, 1985). At the time of hatching, egg diameter ranges between 0.8-1.27 mm (Smith, 1985).

Larvae/Juveniles

At the time of hatching, YSL alewives measure 5 mm TL (Bigelow & Schroeder, 1953). The transition from the yolk sac larvae to preflexion larvae, which is marked by the complete absorption of the yolk sac, occurs at a length of 6.35 mm. Within a month of hatching, the total length of young alewives reaches 15 mm (Bigelow & Schroeder, 1953). Transformation larvae, i.e. stage between postflexion larvae and juveniles, measure 20.3 mm in length (Wang & Kernehan, 1979: in DEIS, 1999). By the autumn, young alewives have attained a length of 102-115 mm TL (Bigelow & Schroeder, 1953).

Esox lucius **(northern pike)**

The northern pike, introduced into the Charles as a recreational fishing species, is distributed holarctically, ranging from northwestern Europe across northern Asia, to northern North America. In North America they range from Alaska to Labrador, south through New England and much of New York, the northern part of the Ohio Valley, the Great Lakes region, and southward to Missouri and Nebraska (Smith, 1985). The body of the northern pike is elongate, arrow shaped, and moderately compressed (Smith, 1985). Dorsal and anal fins are situated far back along the body with strongly convex margins (Smith, 1985). Caudal fins are shallowly forked, pelvic fins are abdominal and rounded, pectoral fins are low, their bases horizontal (Smith, 1985). The northern pike is dark green above, shading to white below. The upper sides are flecked with gold spots at the tips of the scales. In juveniles, these spots are in vertical rows and in smaller juveniles they are fused into pale bars (Smith, 1985).

The northern pike occurs in the weedy parts of rivers, ponds and lakes. Smith (1985) reports that larger fishes move offshore to deeper waters during the highest summer temperatures but the young remain near the shore. Thermal tolerances for the northern pike indicate that upper lethal temperatures are 84 °F (29 °C) while optimal growth occurs from 66-77 °F (19-25 °C) (Casselman, 1978; Bevelheimer et al., 1985; Jacobson, 1992). The lower bound of tolerable dissolved oxygen levels was reported to be 3 mg DO/l (Headrick & Carline, 1993).

Eggs

The northern pike is a spring spawner that initiates breeding activities soon after the ice disappears and water temperatures reach 4.4-11 °C (Smith, 1985). Spawning usually takes place in vegetated areas, often in marshes that will dry up by summer (Smith, 1985). Spawning behavior is diel, taking place during the afternoon between 2:00 and 5:00 pm and may range in duration from a few days to a month (Smith, 1985; Franklin & Smith, 1965; in Wang, 1986). On the average, a female produces 9,000 eggs per unit pound of body weight and a single female can produce more than 59,000 eggs (Smith, 1985). Specifically, regression predicted fecundity (number of eggs produced during the first year by an individual northern pike) was expressed as $Y = 4401.4X – 66,245$, where Y = number of eggs and X = total length in inches) (Franklin & Smith, 1963; in Wang, 1986). Female pike weighing 0.75 pounds may produce from 9,000-10,000 eggs while a 10 lb. fish can produce 100,000 eggs. The eggs range in diameter from 2.5 to 3.0 mm and are adhesive.

Larvae/Juveniles

Transitional postflexion PYSL and early phase juvenile northern pike measure 10-12.5 mm. Beyond this point, growth is rapid and the young average approximately 152.4 mm by the end of the first summer (Smith, 1985).

Ictalurus punctatus **(channel catfish)**

Channel catfish were introduced into the Charles as a recreational fishing species. They have deeply forked tails which is a distinctive feature which separates this species from that of the bullhead catfish (Smith, 1985). The body is moderately elongate, somewhat compressed posteriorly (Smith, 1985). The profile is straight to the origin of the dorsal fin, which is pointed. The anterior-most ray of the dorsal fin is the longest (Smith, 1985). The caudal fin is deeply forked, it's middle rays about half as long as the longest upper rays. In a similar manner to other Ictalurids, the color of the channel catfish is somewhat varied (Smith, 1985). Young catfish are blue gray, shading to paler on the underside with some silver coloration (Smith, 1985). Large fish tend to be a bit darker.

The channel catfish can be found in larger streams where it is able to thrive in moderate channel flow velocities and can tolerate dissolved oxygen levels as low as 0.95 ppm and ambient water temperatures in excess of 90 °F (31.9 °C) (Smith, 1985). Interestingly, studies conducted on western United States channel catfish populations have indicated that the channel catfish will actively spawn within a thermal discharge plume with no adverse effects (Wang, 1986).). The species forages along the bottom and is considered a benthic or demersal species, seldom being present in the water column.

Eggs

Spawning begins in the late Spring when water temperatures range between 75-85 °F (23.6-29.1 °C) (Smith, 1985). Nests are constructed by the male under log or rocks at depths ranging from a few inches to several feet (Smith, 1985). The fecundity for females has been reported as ranging from a low of 1,000 (Jearld & Brown, 1971; in Wang, 1986) to a high of 70,000 (Carlander, 1953; in Wang, 1986). Presumably, this wide range is an artifact of the age and size of the female. Egg diameter at the morula stage is 3.8 mm and late embryonic stage eggs measure 4.3 mm in diameter. The yolk is yellow at the time of deposition and becomes increasingly brown just before hatching (Brown, 1942). The channel catfish egg does not possess an oil globule, the chorion is transparent to translucent and is covered with gelatinous mucus (Wang, 1986). Eggs are deposited in large clusters, are adhesive and demersal.

Larvae/Juveniles

The length of the channel catfish at hatching ranges from 10.3-11.8 mm TL (Wang, 1986) with a minimum of 6.4 mm reported by McClellan (1954; in Wang, 1986). Upon complete absorption of the yolk sac, PYSL measure 14-15 mm TL (Wang, 1986). Juveniles measure from 17-19.5 mm TL (Wang, 1986). Newly hatched larvae remain in the nesting area then disperse into shallow water (Wang, 1986).

***Morone saxatilis* (striped bass)**

The striped bass is an anadromous member of the Percichthyidae family, following herring into the lower Charles from time to time. They are native to North America and range along the Atlantic coast from the St. Lawrence River to the northeastern portion of the Gulf of Mexico. Striped bass are silver overall and dark olive green gray on the back with seven or eight black horizontal stripes along the sides; teeth on the base of the tongue in parallel patches. Body depth less than 1/3 length; back not arched; dorsal fins are separate. Two sharp spines are present on the preopercle. Sexual dimorphism is exhibited with respect to size whereby females are larger than males (Bigelow & Schroeder, 1953).

Principal spawning populations along the eastern seaboard of the United States include the following: the Hudson River; Delaware Bay and the Delaware River; Chesapeake Bay; Albermarl sound, the Roanoke and Chowan Rivers; the Santee River and the St. Johns River (Bigelow & Schroeder, 1953). Adult striped bass generally feed in near shore waters from summer through late winter. As summer progresses, they migrate northward along the coast, but return to nearshore waters of their natal rivers during the autumn. Once water temperatures rise in the spring, spawning adults begin moving upriver to freshwater spawning areas.

Eggs

Depending on their age and size, females produce up to several million spherical, semi-buoyant adhesive eggs which are deposited and suspended within the water column. The eggs of the striped bass require flow velocities of 30 cm/sec to maintain suspension. The eggs are relatively large and average 3.1mm in diameter although egg size will vary with the size of the female. In lab studies, 88% of eggs hatched at temperatures of 55 °F, with a maximum hatch rate of 97% at 67-69 °F. Moreover, eggs seemed to hatch better when exposed to high irradiance levels (Albrecht, 1964; in Fish & Wildlife Information Exchange/VA Tech, 2000). Optimum salinities for proper egg development were reported between 1.5-3.0 ppt. Factors that influence the survival of eggs include water level fluctuations, wind and wave action, water quality, aquatic and terrestrial cover, air and water temperature, predation, and human activity.

Larvae/Juveniles

At the time of hatching, total larval length (viewed laterally) is typically 3.1 mm. Given that larvae of this size spend 98% of the time in the viscous and intermediate hydrodynamic regimes (of which 23% is in the viscous regime) the larvae burst swim (Fuiman & Webb, 1988) and drift with the currents. The transition from the yolk sac larvae to preflexion larvae, which is marked by the complete absorption of the yolk sac, occurs at a length of 6.35 mm. Transformation larvae, i.e. stage between postflexion larvae and juveniles, measure 25 mm (Fay et al., 1983: in DEIS, 1999). The optimal salinity range for late phase striped bass larvae ranges from 0-10 ppt. The optimal temperature range for larvae was reported between 62-64 °F. Yolk sac larvae optimal salinity ranges are reported as occurring between 5-15 ppt and between 5-25 ppt for post yolk sac larvae.

In an Illinois pond study, juvenile striped bass tolerated dissolved oxygen levels as low as 1.2 mg/l. Lab studies have indicated that increased water flow velocity significantly decreased the area ranged by juvenile striped bass (Bowles, 1975; in Fish & Wildlife Information Exchange/VA Tech, 2000). Juvenile striped bass tolerate salinities ranging between 0-35 ppt and optimum salinity for survival is between 10 and 20 ppt.

***Anguilla rostrata* (American eel)**

The American eel is catadromous, spawning in saltwater and maturing in freshwater. In the common American eel, the dorsal fin originates far behind the pectoral fins. It is this feature which distinguishes it from the conger eel (Bigelow & Schroeder, 1953). The eel has a pointed snout and its gill slits are set vertically on the sides of the neck (Bigelow & Schroeder, 1953). Although this species is closely related to the European eel, the American eel possesses 107 vertebrae while the European species has 115. The colors of the eel closely match the color of the substrate upon which they live. Specifically, they are dark muddy brown to gray above, and tinged with yellow on the sides. The lower surface is paler brown with a yellowish-white underside. The eel exhibits sexual dimorphism with respect to length with mature females measuring 45.7+ cm in length and smaller males measuring 27.9 to 30.5 cm total length.

The American eel spawns in the Sargasso Sea in the spring. The young males then migrate into estuaries and the lower ends of rivers in late fall and winter, while the females move well upriver (Whitworth, Berrien, & Keller, 1968). After several years within a freshwater habitat, the mature fish return to the Sargasso Sea, spawn, and die.

Eggs

Eels are among the most fecund fish with average female fecundity ranging from 5 to 10 million eggs with extreme values ranging up to 20 million eggs (Bigelow & Schroeder, 1953). Bigelow & Schroeder (1953) indicate that once deposited, the eggs are pelagic and remain so until hatching occurs.

Larvae/Juveniles

The leptocephalus stage is quite distinctive in appearance, being ribbon-like and transparent, with a small pointed head. Very young larvae range from 7 to 8 mm in length (Bigelow & Schroeder, 1953). Eels change from the transparent leptocephalus to transparent “glass eels” to the juvenile or elver stage (Castle, 1984; and Tesch, 1977: in Bond, 1996). The American eel undergoes the transition from glass eels (54-59 mm total length) to the elver stage (total length of between 60 and 65 mm) over a period of a year. The elver stage is attained by December or January.

***Perca flavescens* (yellow perch)**

The yellow perch is elongate and somewhat compressed with a symmetrical profile (Smith, 1985). The dorsal origin is located slightly behind the pectoral base with the spiny dorsal fin larger than the second dorsal fin. The caudal fin is moderately forked with an anal fin that originates below the third dorsal ray. The body is completely scaled with an arched lateral line that follows the contour of the dorsal profile (Smith, 1985). The yellow perch is generally yellowish along the sides, grades to olive or brownish above and is abruptly white below (Smith, 1985). Juveniles tend to be a bit greener without the conspicuous red lower fins present on the adults.

Eggs

Spawning takes place in the spring, April or May, when ambient water temperatures reach 45 to 52 °F over a substrate composed of sand, gravel, rubble, or vegetation. During spawning, yellow perch move into shallow weedy areas after which they return to deeper waters in pooled areas of rivers as well as lakes and ponds to complete their life cycle. The eggs of the perch are deposited in zig-zag rows cemented together in a 2 inch wide by up to 7 foot long gelatinous band (Smith, 1985). The egg masses swell considerably once deposited and acquire adhesive properties once fertilized. Smaller females can deposit 3,000 eggs and a large female can deposit as many as 150,000 eggs. The eggs hatch within 2 weeks.

Larvae/Juveniles

Larval yellow perch are poor swimmers and congregate in schools which are heavily predated upon. As few as one in five thousand yellow perch survive the first year of life (Thompson, 1985). Yellow perch grow fairly quickly and reach a maximum length of 150-300 mm.

***Notemigous crysoleucas* (golden shiner)**

The golden shiner belongs to a distinctive group of minnows considered by some to represent a separate sub-family referred to as the *Abraminae* (Smith, 1985). The body of the golden shiner is deep and compressed, profiles equally curved or the ventral profile slightly more curved (Smith, 1985). The dorsal fin is inserted behind the middle of the body, the caudal fin is moderately forked, and the anal fin is long and falcate (Smith, 1985). Adult golden shiners are golden to brassy yellow in hue with dark crescents at the base. The fins are orange-yellow (Smith, 1985). Major prey items of golden shiners include small insects, cladocerans, and zooplankton (Moyle, 1976). Adults will occasionally feed on filamentous algae (Smith, 1985). The golden shiner is characteristic of quiescent habitats, occurring only rarely in stream sections with a noticeable current (Pflieger, 1975).

Eggs

Adult golden shiner spawn in late spring when the ambient water temperatures exceed 68 °F. The spawning season lasts from May to august in New York although the duration of spawning is somewhat longer further north (Smith, 1985). Although breeding behavior has not been described, it is known that the eggs are both demersal and adhesive and are distributed via broadcasting with no nesting or parental care (Smith, 1985). Eggs do not possess an oil globule, the chorion is smooth and transparent, and the perivitelline space ranges from 0.1-0.2 mm in width.

Larvae/Juveniles

Total length (TL) at hatching ranges from 2.7 mm (Snyder et al.1977) to 4.5 mm TL (Lippson & Moran, 1974). Upon the absorption of the yolk sac, early phase (pre-flexion) post yolk sac larvae measure 4.5-6.8 mm TL (Snyder et al., 1977; Wang & Kernehan, 1979). Growth for the golden shiner is fairly rapid, as exhibited by New York populations, whereby young fishes can reach total lengths ranging from 53 to 74 mm by October of their first year (Smith, 1985). Year 2 fishes are considered mature (Smith, 1985).

Larvae are distributed primarily near the surface of shallow, weedy creeks, ponds, lakes and reservoirs, occasionally in open water. Juveniles are observed in both shallow and open warm waters of pools, creeks, ponds, ditches, lakes and reservoirs.

***Cyprinus carpio* (common carp)**

The common carp is a Eurasian species with two pairs of well-developed barbels and three rows of pharyngeal teeth (Smith, 1985). In a similar manner to goldfish, it possesses strong serrated spine-like rays at the front of the dorsal and anal fins. However, the carp is distinguished from the goldfish through the presence of numerous, small scales (35-39 in the lateral line), the presence of two pairs of barbels on the upper jaw, and three rows of teeth on the pharyngeal arch (Smith, 1985). The body of the carp is moderately elongate, thick and slab-sided with a dorsal profile that is more rounded than that of the ventral profile (Smith, 1985). The dorsal fin is long and possesses a hard ray along the front margin of the dorsal fin, which has a double row of teeth along the posterior margin (Smith, 1985). The caudal fin is moderately forked with rounded lobes while the anal fin is short with a serrated anterior ray. Two pairs of barbels are present on the upper jaw. Carp are generally a brassy gold to brown or olive above, shading to silver, white, or yellow below. The scales of the upper sides have prominent dark margins with a concentration of pigment at the base of each scale.

Carp are generally restricted to lakes, ponds, and larger streams (Smith, 1985). Typically, they are most abundant where there are dense stands of submersed macrophytes, although their feeding activities result in the destruction of these stands and contributes to elevated suspended solids. Although not as bottom oriented as catfish and bullheads, carp do tend to forage along bottom substrates frequently and can be considered a somewhat demersal species.

<u>Eggs</u>

Carp have a protracted spawning period from late spring to early August, beginning when the ambient water temperatures reach 17 °C. Spawning may be interrupted if the water temperature falls below 18 °C. Acceptable spawning temperature ranges have been cited from 15-28 °C (Swee & McCrimmon 1966; Moyle, 1976; in), optimal spawning temperatures range from 18-22 °C (Berg, 1964; Mansueti & Hardy, 1967; in), and peak spawning behavior is observed when ambient water temperatures range from 22-26 °C (in study). According to research conducted on New York populations, there is a distinctly diel trend in spawning, taking place during daylight hours only. Eggs are highly adhesive throughout the incubation period and demersal. They are distributed via broadcast spreading during which time a female measuring 393.7 mm can deposit 36,000 eggs (Smith, 1985) while a fish measuring 850.9 mm can deposit up to 2,208,000 eggs (Smith, 1985).

The eggs measure 1.5-2.1 mm in diameter although diameters as low as 1.0 mm have been reported (Slastenenko, 1958; in Wang, 1986). Within carp eggs there is generally no oil globule, although other researchers have noted many minute oil globules (Brinley, 1937; in Wang, 1986), the chorion is transparent although detritus affixed to the chorion can render the chorion translucent, the perivitelline space is generally 20% of egg radius, e.g. the perivitelline space of a 1.5 mm diameter egg = 0.15 mm.

<u>Larvae/Juveniles</u>

At the time of hatching carp larvae average between 4.4-5.7 mm TL (Swee & McCrimmon, 1966; in Wang, 1986) although minimum lengths of 3.0 mm TL have been reported (Sigler, 1955; in Wang, 1986). Upon complete absorption of the yolk sac (PYSL), larvae generally measure between 6.0-7.0 mm TL, although slightly higher ranges of 7.0-9.5 mm TL have been reported (Jones et al., 1978; in Wang, 1986). YSL are demersal (in Wang, 1986) while late phase carp larvae can be planktonic (Moyle, 1976; in Wang, 1986). Both phases can be found in shallow, weedy and muddy habitats.

Juveniles are found in those areas that afford protection from predation (Wang, 1986). As growth proceeds, i.e. >100 mm TL, carp juveniles move into deeper water and form schools (Wang, 1986).

Pomoxis nigromaculatus (black crappie)

Crappies are recognized by their highly compressed, diamond-shaped bodies, the presence of more than three anal spines, and their short dorsal fins (Smith, 1985). The spiny part of the dorsal fin is deeply incised. The soft dorsal is arched with it's posterior angle rounded (Smith, 1985). The caudal fin is slightly forked with blunt lobes and the pelvic fin is inserted below the upper base of the pectoral fin. Gill membranes are separate. The black crappie is pale silvery white on the sides and undersides, dark green dorsally with dense patches of dark scales that coalesce to form irregular patterns (Smith, 1985). There is a dark vertical bar through the eye and suborbital region. The vertical fins are dusky, with pale spots in irregular rows.

Eggs

The spawning season spans from May to July when the ambient water temperatures are greater than 68 °F (19.8 °C). Nests are built on sandy bottoms within submersed macrophyte stands. The adhesive, demersal eggs measure slightly less than 1 mm in diameter (0.93 mm) (Scott & Crossman, 1973; in Wang, 1986) and hatch in 3 to 5 days (Smith, 1985). The yolk is whitish (Scott & Crossman, 1973; in Wang, 1986), a single oil globule is present (Hardy, 1978; in Wang, 1986) and the chorion in unfertilized eggs is transparent, elastic, and smooth (Wang, 1986).

Larvae/Juveniles

At the time of hatching, black crappie larvae measure 2.32 mm TL (Seifert, 1969; in Wang, 1986) while late phase larvae measure 11.6 mm TL (Wang, 1986). Early phase juveniles measure 16 mm TL while late phase juveniles measure 43 mm TL (Wang, 1986). PYSL feed on planktonic organisms including copepod nauplii initially, then Cyclops, and finally graduating to cladocerans (Smith, 1985). Juvenile crappies feed nocturnally on insects and other fish (Smith, 1985).

Ictalurus nebulosus (brown bullhead)

The brown bullhead is the most common member of its family and is variable in it's coloration (Smith, 1985). The brown bullhead possesses a "flag-like" adipose dorsal fin, the head and anterior body is compressed, and the caudal peduncle is also somewhat compressed (Smith, 1985). The anal fin origin is located at a point between the end of the dorsal fin base and the beginning of the adipose dorsal fin (Smith, 1985). The brown bullhead is olive to blackish above grading to pale white or yellow on the underside. The sides are mottled and the fins are dark but not nearly so as the head. All barbels are gray to black, the base of the chin is sometimes paler in hue (Smith, 1985).

The brown bullhead occupies a variety of habitats from the Great Lakes to small ponds and the quiescent portions of streams (Smith, 1985). It has been observed that this species favors deeper waters than other bullheads (Trautman, 1957; in Smith, 1985). The species forages along the bottom and is considered a benthic or demersal species, seldom being present in the water column.

Eggs

The brown bullhead spawns in late May and June when the water temperatures reach 80.6 °F (27 °C). Once deposited, the eggs adhere in a pale yellow lump and hatching does not occur until 6-9 days at 69 °F (20.35 °C). The eggs are spherical, adhesive (Breder, 1935; in Wang, 1986) and demersal. The diameter of unfertilized eggs ranges from 3.0-3.4 mm (Wang, 1986), while fertilized eggs measure 3.0 mm (Breder, 1935; in Wang, 1986). The yolk is pale cream in color (Scott & Crossman, 1973; in Wang, 1986), there is no oil globule and the chorion is transparent (Armstrong, 1962; in Wang, 1986) or nearly so (Breder, 1935; in Wang, 1986). Scott & Crossman (1973; in Wang, 1986) indicate that the eggs are covered with gelatinous mucus.

Larvae/Juveniles

At the time of hatching yolk sac larvae measure 6.0 mm TL (Scott & Crossman, 1973; in Wang, 1986) while PYSL measure approximately 12.2 mm TL (Wang, 1986). Newly hatched larvae have no pigments and are cream white (Breder, 1935; in Wang, 1986). After 1 to 2 days after hatching, dark pigmentation covers head finfolds and barbels Wang, 1986). Larvae remain closely packed together in a tight mass within the nesting area for approximately seven days (Scott & Crossman, 1973; in Wang, 1986).

By the time brown bullheads have reached the juvenile stage, they measure approximately 20.8 mm TL (Wang, 1986) and are distributed primarily in quiescent zones of rivers and reservoirs

***Esox niger* (chain pickerel)**

Adult chain pickerel have a distinctive, reticulated pattern of narrow black lines on a bright brassy or greenish background (Smith, 1985). It is distinguished from the northern pike in that it possesses fully scaled cheeks and gill covers. The body is elongate, sagittate, and somewhat compressed (Smith, 1985). Dorsal and anal profiles are nearly equally curved. The dorsal fin originates rather far back and is situated between the origin of the pelvic fin and the midbase of the caudal fin (Smith, 1985). Teeth are present on premaxillary, maxillary, vomer, palatine, tongue and basibranchials (Smith, 1985). The adult ground color is dark green or brownish above, shading to brassy yellow on the flanks, and is white ventrally. The back is marked by irregular mottles and bars. Sides exhibit a reticulated pattern of dark lines that is highly suggestive of chain links (Smith, 1985). The tip and leading edge of the anal fin often possess an orange coloration.

Eggs

Although ripe fishes have been observed as late as September (Smith, 1985) the chain pickerel is normally a Spring spawner with spawning activity taking place when ambient water temperatures reach 47-52 °F (8.25-11 °C). The eggs are adhesive and as such adhere readily to submersed macrophytes.

Larvae/Juveniles

Young chain pickerel reach a total length of 101.2 mm by the end of the first summer (Smith, 1985).

***Notropis hudsonius* (spottail shiner)**

The spottail shiner is a small, silvery freshwater minnow in the Cyprinidae and is a slim fish with a blunt head and subterminal mouth (Smith, 1985). It has eight anal rays and a variable pharyngeal tooth count (Smith, 1985). The general body morphology is elongate, and ranges from terete to slab-sided (Smith, 1985). The dorsal fin is deltoid, retrogressive, with a concave margin and angulate corners (Smith, 1985). The caudal fin is moderately forked, with bluntly pointed lobes (Smith, 1985). The upper sides of the spottail shiner are olive down to the second scale row. The lower margin of the caudal fin is white (Smith, 1985). Perhaps the most distinctive feature of the spottail shiner is the presence of a large oval black spot at the base of the caudal fin, which varies in shape with the size of the fish (Smith, 1985).

Spottail shiner occur in a variety of habitats from large lakes and rivers to small streams and appear to favor clear waters.

Eggs

Adult spottail shiners may form large spawning aggregations over sand or gravel substrates in shallow water or at the mouths of tributaries. Estimates of spottail shiner fecundity, i.e. the number of eggs in the first stage of the life cycle produced by an individual, range from 100 to 2,600 eggs per female (Wang, 1986). Wang & Kernehan, (1979, in Wang, 1986) report that eggs are demersal and adhesive and measure 1.0 mm to 1.4 mm in diameter. Although the life history of the spottail shiner has not been thoroughly studied, a few comments regarding the temporal features of spawning behavior can be made based upon Hudson River populations. Spottail shiner spawning takes place in June or July over a sandy substrate (Smith, 1985). Based upon the temporal distribution of peak larval abundance within the Hudson River, the spawning activities of spottail shiner may be slightly earlier.

Larvae/Juveniles

Newly hatched yolk sac larvae are approximately 4.7 mm in length. The transition to preflexion larvae, which is marked by the complete absorption of the yolk sac, occurs at a length of 6.0 mm total length. Within a month of hatching, the total length of young spottail shiner reaches 12.7 mm. Transformation larvae, i.e. stage between postflexion larvae and juveniles, measure 18 mm in length (Wang & Kernehan, 1979: in Wang, 1986.

Alosa sapidissima (American shad)

The American shad is the largest of the river herrings (Smith, 1985). The body is strongly compressed, deepest anterior to the dorsal fin, the ventral profile more strongly curved than the dorsal (Smith, 1985). The dorsal fin is deltoid and with a straight margin and sharp corners (Smith, 1985). The caudal fin is deeply forked with two longitudinal folds on each side of the base (Smith, 1985). The pectoral fins are low and horizontal (Smith, 1985). American shad are bright silvery on the sides grading to bluish or greenish-gray above (Smith, 1985). The lining of the body cavity is pale gray to silvery (Smith, 1985).

As an anadromous species, shad spend most of their lives at sea and only enter freshwater to spawn (Smith, 1985). After spawning, adults return to the sea. As an anadromous migratory species, shad require coastal rivers and streams without dams or blockage in order to complete their life cycle. In addition, studies of shad in the Delaware River reported that periods of decline could be attributed to construction of dams without fish passage and to water pollution resulting in dissolved oxygen reduction (Sykes and Lehman, 1957; Chittenden, 1974). Sykes and Lehman refer to an area below Torresdale where dissolved oxygen fell to near zero during summer months in this area of pollutant concentration, low flow and small tidal action, forming impassable barriers to migrating fish. They go on to say that heavy mortalities to shad during the outmigration "undoubtedly were caused by the lethal effects of the low dissolved-oxygen content of the water." Chittenden concluded that dissolved oxygen levels influence the adult upstream migration success but that DO levels are lower in the fall and result in the destruction of the young as they move to the sea.

Eggs

Preferential spawning habitat includes broad, shallow flats located within the main body of coastal rivers. River flow over these shallow flats is moderate. Spawning behavior has been observed to occur during overcast afternoons or early evening hours. Estimates of American shad fecundity, i.e. the number of eggs in the first stage of the life cycle produced by an individual, range from 116,000 to 468,000 eggs per female (Lehman, 1953; in DEIS, 1999). American shad egg masses are semi-buoyant and initially slightly adhesive (Wang & Kernehan, 1979; in Wang, 1986), later becoming non-adhesive (Hildebrand, 1963; in Wang, 1986). Egg diameter at the time of water hardening ranges from 2.5 mm to 4.4 mm (Wang, 1986).

Larvae/Juveniles

Newly hatched larvae range in total length from approximately 6.5-10 mm TL (Wang, 1986). Upon complete absorption of the yolk sac, PYSL measure 10-12 mm TL (Wang, 1986). Larvae are pelagic and newly hatched larvae gradually move to the sea (Moyle, 1976; in Wang, 1986). Within 21-28 days of hatching, the total length of young American shad reaches 20 mm. At the time that they emigrate from the respective riverine system at the end of the summer, juvenile American shad range in length from 38.1 to 114.3 mm (Bigelow & Schroeder, 1953).

***Ictalurus catus* (white catfish)**

The white catfish is a moderately sized member of the Ictaluridae introduced into the Charles (Smith, 1985). This particular species possesses a forked tail, depressed head and dorsal spine with serrae (Smith, 1985). The body is moderately elongate, head depressed, body compressed posteriorly (Smith, 1985). The caudal fin is forked, with rounded lobes (Smith, 1985). The margin of the anal fin is rounded, the pelvic fin is pointed, and the pectoral fin is bluntly rounded (Smith, 1985). The white catfish is gray to gray blue dorsally, shading to white below (Smith, 1985). White catfish prefer fresh and slightly brackish waters and moderate water currents and are found in river channels and streams with a sluggish flow regime. They avoid high salinity levels.

Eggs

Spawning occurs when water temperatures reach approximately 69.62 °F in late June and early July. A female measuring 27.9 cm will deposit 3200-3500 eggs within a 1m-diameter nest, which is oftentimes constructed on submerged sand and gravel deposits. At the time of hatching the spherical eggs range in diameter from 4.0-5.5 mm (Wang, 1986). The eggs are both demersal and very adhesive (Wang, 1986).

Larvae/Juveniles

At the time of hatching, white catfish yolk sac larvae are 9.0-10.0 mm total length (Wang & Kernehan, 1979; in Wang, 1986) and grow to 14 mm total length in five to six days upon absorption of the yolk sac (Wang, 1986). Prolarvae remain in the nest and then disperse into shallow waters with muddy bottoms (Wang, 1986). Transitional PYSL/Juveniles measure 16.6 mm TL (Wang, 1986). In southern waters juvenile white catfish are 76.2 mm in length at the end of the first growing season. They continue to grow slowly thereafter, attaining lengths of 43.1 cm at age 8.

***Osmerus mordax* (rainbow smelt)**

The smelt is a slender, elongate fish with a bright silvery stripe along the side of it’s body (Smith, 1985). Rainbow smelt are an anadromous species. The body is slender, little compressed, and slightly ovate cross-sectionally (Smith, 1985). Cycloid scales number 62-72 in lateral series; the peritoneum is silver with dark speckles (Buckley, 1989; in Fish & Wildlife Information Exchange/VA Tech, 2000). The color is transparent olive to pale green on the back; the sides are similar, each with a broad longitudinal silvery band (Buckley, 1989; in Fish & Wildlife Information Exchange/VA Tech, 2000).

Eggs

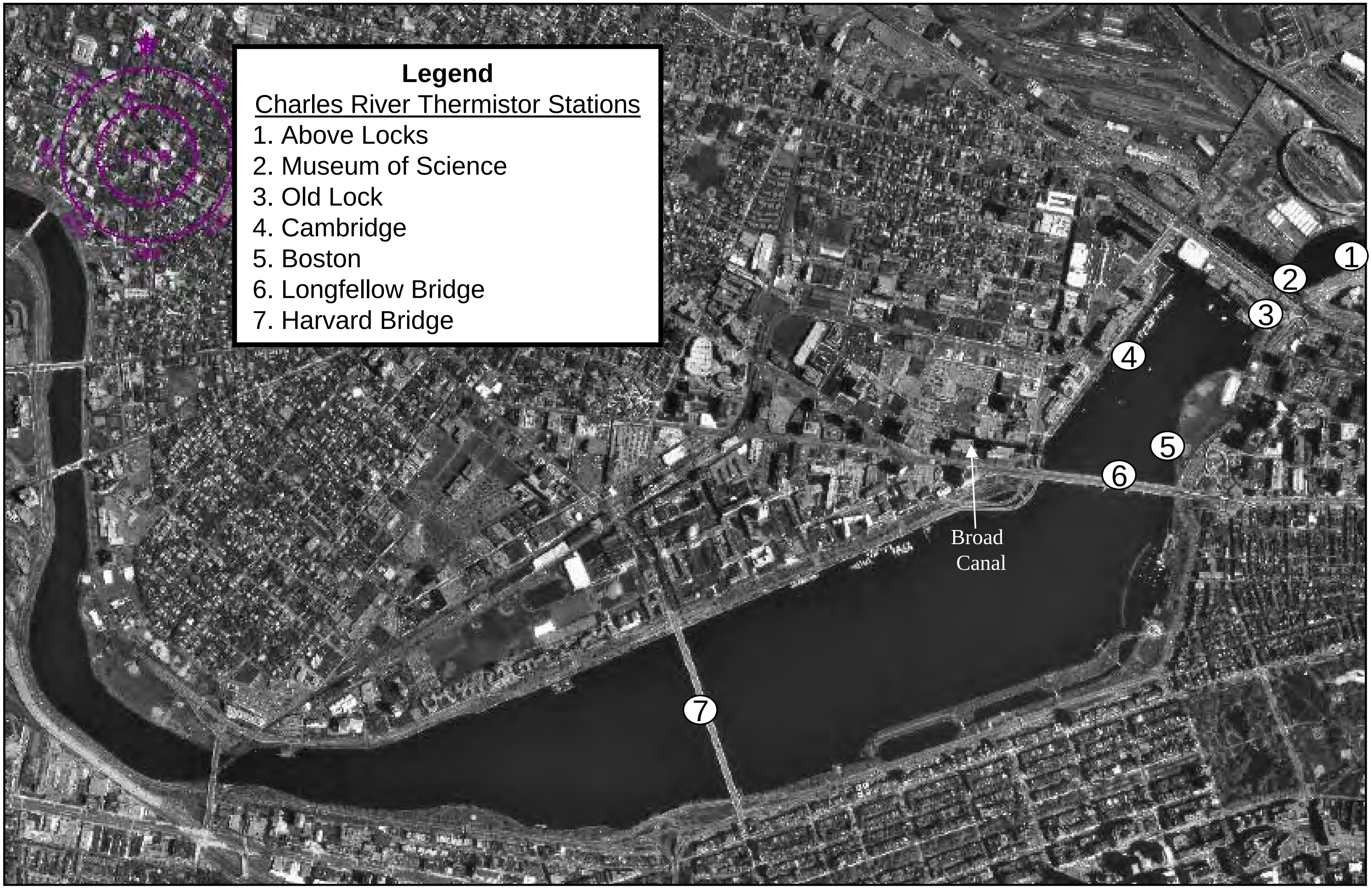
Estimates of rainbow smelt fecundity, range from 7,000 to 70,000 eggs per female. Rainbow smelt egg masses are demersal, adhesive, irregular in shape, and contain a granular yellow yolk with numerous oil globules. Typically, unfertilized egg diameter ranges from 0.8 mm to 0.9 mm while fertilized eggs are approximately 1.0 mm to 1.6 mm. The eggs hatch in 19 days at 48.2-50 °F and in 29 days at 42.8-44.6 °F (Scott & Crossman, 1973: in DEIS, 1999). Water velocity, substrate type, and egg density appear to be important factors in egg survival (Buckley, 1989; in Fish & Wildlife Information Exchange/VA Tech, 2000).

Larvae/Juveniles

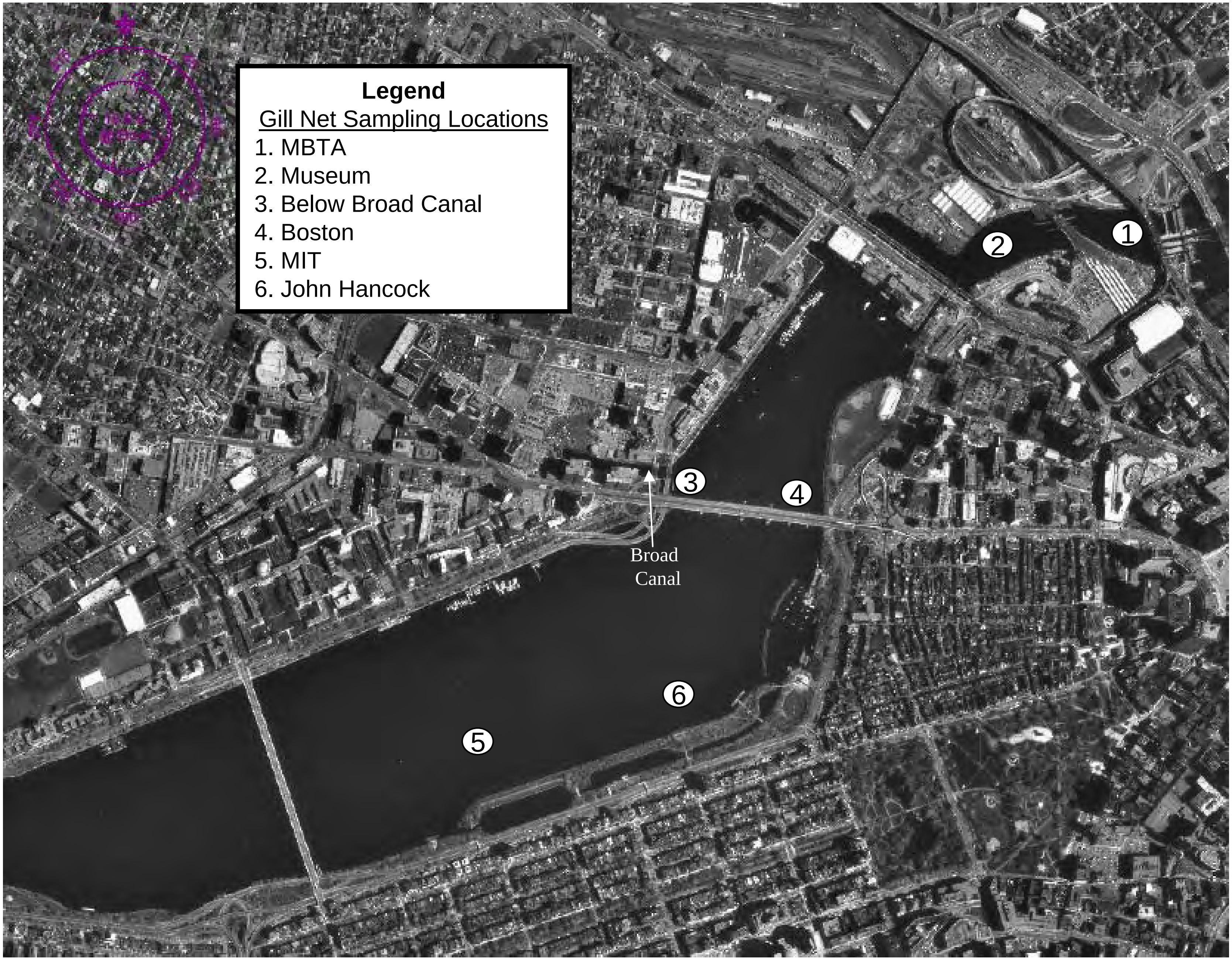
Newly hatched larvae range from approximately 5.08 mm to 6.09 mm in length (Buckley, 1989; in Fish & Wildlife Information Exchange/VA Tech, 2000). The transition from the yolk sac larvae to preflexion larvae, which is marked by the complete absorption of the yolk sac, occurs at a length of 6.35 mm. Within a month of hatching, the total length of young Rainbow smelt reaches 12.7 mm. Transformation larvae, i.e. stage between postflexion larvae and juveniles, measure 36 mm in length. Juvenile smelt grow quickly and are at least 50.8 mm TL by the month of August.

ATTACHMENT D

Biological Sampling Stations in the Lower Charles River

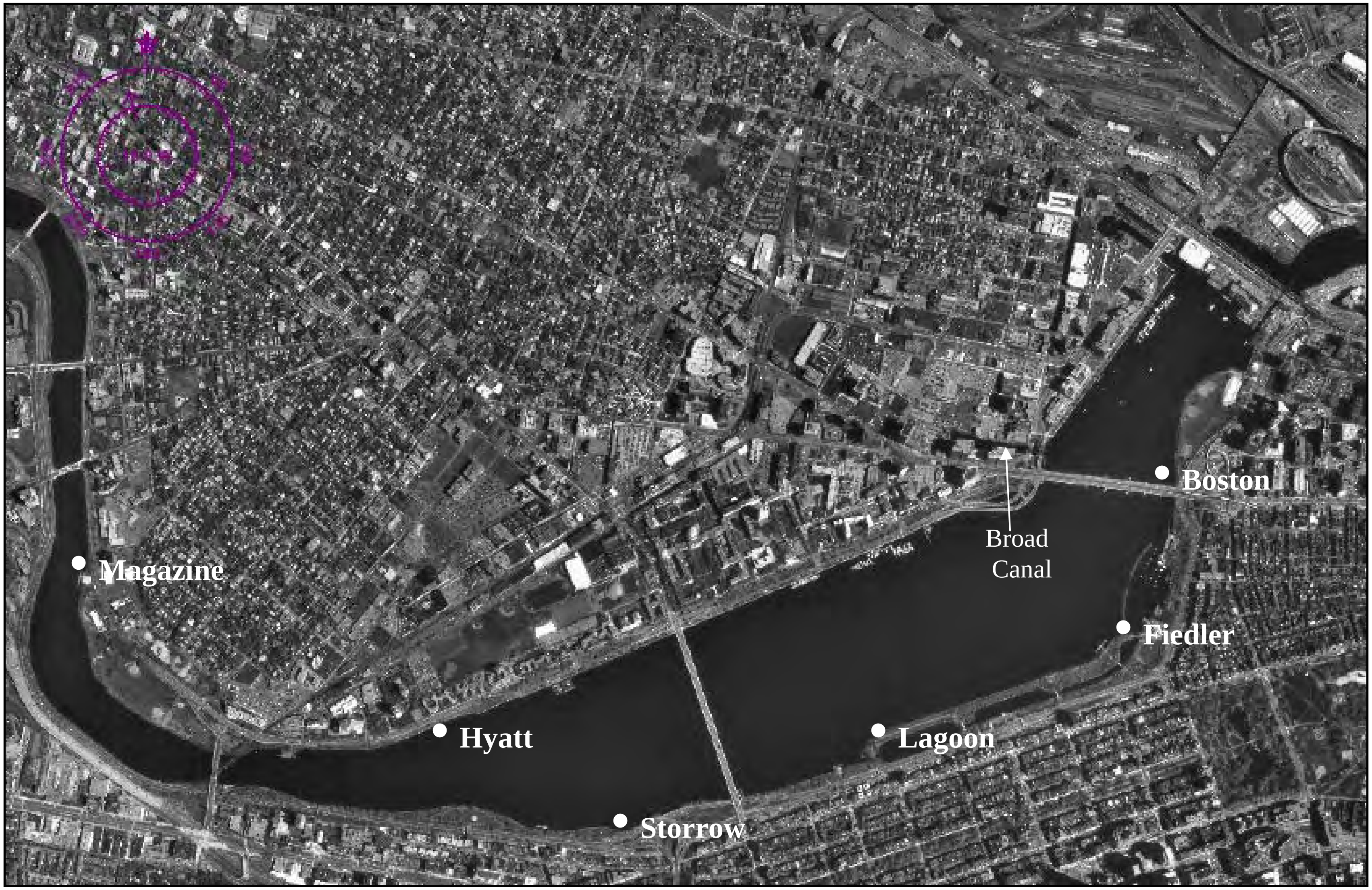


Charles River Thermistor Stations


Legend
Gill Net Sampling Locations
1. MBTA
2. Museum
3. Below Broad Canal
4. Boston
5. MIT
6. John Hancock
Broad Canal
1
2
3
4
5
6

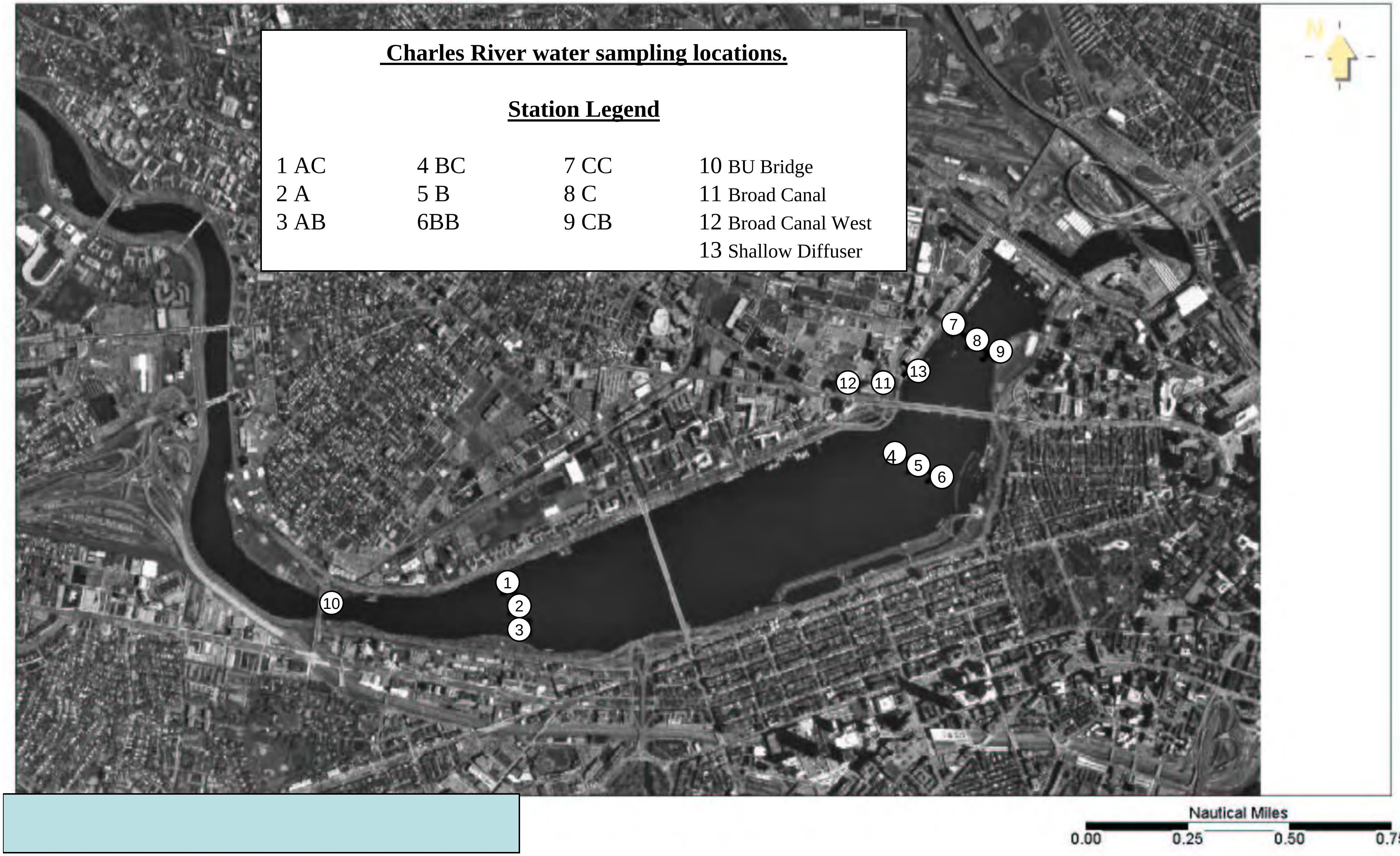
Ichthyoplankton Sampling Locations

Pushnet Sampling Locations



Beach seine sampling locations

BOSTON SOUTH NW, MA.
USGS Chart 42071C11 (Maptech Photo CD) Depth Units: Datum:



ATTACHMENT E

Agency Correspondence

TRC

Wannalancit Mills
650 Suffolk Street, Suite 200
Lowell, MA 01854

978.970.5600 PHONE
978.453.1995 FAX

www.TRCsolutions.com

October 1, 2008

Supervisor, U.S. FWS Region 5
New England Field Office
US Fish and Wildlife Service
70 Commercial St., Suite 300
Concord, NH 03301

Ref: Massachusetts Institute of Technology, Notice of Intent for Coverage Under the Massachusetts General Permit for Non-Contact Cooling Water – Threatened or Endangered Species Review

Dear Environmental Reviewer:

The Massachusetts Institute of Technology (MIT) is preparing a Notice of Intent (NOI) to seek coverage under the National Pollutant Discharge Elimination System General Permit for Non-Contact Cooling Water (Permit No. MA250000). General permit coverage is being requested for two existing intake and outfall structures, designated 002 and 003, located along the Charles River in Cambridge, Massachusetts. An intake and outfall location map is attached as Figure 1. Figure 2 shows the intake and outfall locations on an aerial photograph of the site and surrounding area. In accordance with NOI filing requirements, this letter requests agency input relative to threatened or endangered species in the project vicinity, designated critical habitat or essential fish habitat that may potentially be impacted by the operation of these structures.

Authorization to discharge non-contact cooling water was granted to MIT in 1974 under NPDES Permit No. MA0000795. The permit covered four outfalls, designated 001, 002, 003, and 004. Outfalls 001 and 004 are no longer used for the discharge of once through cooling water by MIT and there are no plans to use these outfalls for non-contact cooling water at this time. Outfall 002, which addressed non-contact cooling water for the Magnet Laboratory and for air conditioning, is currently active and will continue to be operated on an intermittent basis for equipment cooling. Outfall 003, which was used primarily for power plant non-contact cooling, is no longer required for electric power generation, but is scheduled for reactivation to support engine research efforts directed at improving fuel economy and operating efficiency.

MIT's existing NPDES permit authorizes the discharge up to 6.0 million gallons per day (mgd) of non-contact cooling water through Outfall 002 and up to 6.72 mgd from Outfall 003. Current non-contact cooling water requirements for Outfall 002, totaling up to 0.18 mgd, are significantly less than under the existing NPDES permit. It should also be noted that this outfall is only required on an intermittent basis to support research efforts. Therefore, MIT is requesting that the maximum daily flow for Outfall 002 be reduced from 6.0 mgd to 0.18 mgd. The average monthly flow for this outfall will be considerably less. Projected future non-contact cooling water requirements for Outfall 003 are anticipated to total 0.5 mgd to support engine research activities. Therefore, MIT is requesting that the maximum daily flow for Outfall 003 be reduced from 6.72 mgd to 0.5 mgd. With these reductions in the maximum daily discharge flow coupled with deactivation of Outfalls 001 and 004, the total non-contact cooling water flow for the Facility will be less than 0.7 mgd.

Under the Massachusetts General Permit for Non-Contact Cooling Water, the discharge from Outfalls 002 and 003 is required comply with the following:

- The maximum daily discharge temperature cannot exceed 83°F;
- The discharge cannot raise the receiving water temperature by more than 5°F;
- The Total Residual Chlorine (TRC) concentration in the discharge must comply with applicable water quality based limits;
- The pH of the discharge must be greater than or equal to 6.5 S.U. and less than or equal to 8.3 S.U., unless this range is expanded to the Federal limit of 6.0 S.U. to 9.0 S.U. with the concurrence of MassDEP and EPA; and
- The pH of the discharge shall not be more than 0.5 S.U. outside the background range of the receiving water.

For operation of an intake structure, the applicant must also comply with the general permit's requirements for using the "Best Technology Available (BTA)" for minimizing potential adverse impacts associated with impingement and entrainment of aquatic life. The intake structures associated with Outfalls 002 and 003 were installed in 1961 and 1915, respectively. At that time, intake design flows were significantly greater than existing permitted flows. Further reducing permitted flow to less than 0.7 mgd for both outfalls will eliminate potential impacts associated with impingement of aquatic life and also reduce potential impacts associated with entrainment. Therefore, operation of these structures is not anticipated to pose a significant adverse impact on the aquatic resources of the lower Charles River.

Appendix 2 of the General Permit indicates that there are four listed species of concern to facilities seeking permit coverage, namely the shortnose sturgeon, the dwarf wedge mussel, the bog turtle, and the northern redbelly cooter. The shortnose sturgeon is listed under the jurisdiction of NOAA Fisheries and the dwarf wedge mussel, the bog turtle, and the northern redbelly cooter are listed under the jurisdiction of the U.S. Fish and Wildlife Service. None of the above species are believed to be present within the lower Charles River Basin. Therefore, no adverse impacts to these species are anticipated.

Your review relative to threatened or endangered species is greatly appreciated. The Massachusetts Natural Heritage & Endangered Species Program and the National Marine Fisheries Service (NMFS) have also been contacted for input.

TRC would like to thank you in advance for your efforts in reviewing this material. If you have any questions or require further information, please do not hesitate to contact me directly at (978)-656-3570. Thank you for your assistance.

Sincerely,
TRC Environmental Corporation

David E. Schafer
Senior Water Resources Engineer

TRC

Wannalancit Mills
650 Suffolk Street, Suite 200
Lowell, MA 01854

978.970.5600 PHONE
978.453.1995 FAX

www.TRCsolutions.com

October 1, 2008

Massachusetts Natural Heritage & Endangered Species Program
Division of Fisheries and Wildlife
Route 135
Westborough, MA 01581

Ref: Massachusetts Institute of Technology, Notice of Intent for Coverage Under the Massachusetts General Permit for Non-Contact Cooling Water – Threatened or Endangered Species Review

Dear Environmental Reviewer:

The Massachusetts Institute of Technology (MIT) is preparing a Notice of Intent (NOI) to seek coverage under the National Pollutant Discharge Elimination System General Permit for Non-Contact Cooling Water (Permit No. MA250000). General permit coverage is being requested for two existing intake and outfall structures, designated 002 and 003, located along the Charles River in Cambridge, Massachusetts. An intake and outfall location map is attached as Figure 1. Figure 2 shows the intake and outfall locations on an aerial photograph of the site and surrounding area. In accordance with NOI filing requirements, this letter requests agency input relative to threatened or endangered species in the project vicinity, designated critical habitat or essential fish habitat that may potentially be impacted by the operation of these structures.

Authorization to discharge non-contact cooling water was granted to MIT in 1974 under NPDES Permit No. MA0000795. The permit covered four outfalls, designated 001, 002, 003, and 004. Outfalls 001 and 004 are no longer used for the discharge of once through cooling water by MIT and there are no plans to use these outfalls for non-contact cooling water at this time. Outfall 002, which addressed non-contact cooling water for the Magnet Laboratory and for air conditioning, is currently active and will continue to be operated on an intermittent basis for equipment cooling. Outfall 003, which was used primarily for power plant non-contact cooling, is no longer required for electric power generation, but is scheduled for reactivation to support engine research efforts directed at improving fuel economy and operating efficiency.

MIT's existing NPDES permit authorizes the discharge up to 6.0 million gallons per day (mgd) of non-contact cooling water through Outfall 002 and up to 6.72 mgd from Outfall 003. Current non-contact cooling water requirements for Outfall 002, totaling up to 0.18 mgd, are significantly less than under the existing NPDES permit. It should also be noted that this outfall is only required on an intermittent basis to support research efforts. Therefore, MIT is requesting that the maximum daily flow for Outfall 002 be reduced from 6.0 mgd to 0.18 mgd. The average monthly flow for this outfall will be considerably less. Projected future non-contact cooling water requirements for Outfall 003 are anticipated to total 0.5 mgd to support engine research activities. Therefore, MIT is requesting that the maximum daily flow for Outfall 003 be reduced from 6.72 mgd to 0.5 mgd.

With these reductions in the maximum daily discharge flow coupled with deactivation of Outfalls 001 and 004, the total non-contact cooling water flow for the Facility will be less than 0.7 mgd.

Under the Massachusetts General Permit for Non-Contact Cooling Water, the discharge from Outfalls 002 and 003 is required comply with the following:

- The maximum daily discharge temperature cannot exceed 83°F;
- The discharge cannot raise the receiving water temperature by more than 5°F;
- The Total Residual Chlorine (TRC) concentration in the discharge must comply with applicable water quality based limits;
- The pH of the discharge must be greater than or equal to 6.5 S.U. and less than or equal to 8.3 S.U., unless this range is expanded to the Federal limit of 6.0 S.U. to 9.0 S.U. with the concurrence of MassDEP and EPA; and
- The pH of the discharge shall not be more than 0.5 S.U. outside the background range of the receiving water.

For operation of an intake structure, the applicant must also comply with the general permit's requirements for using the "Best Technology Available (BTA)" for minimizing potential adverse impacts associated with impingement and entrainment of aquatic life. The intake structures associated with Outfalls 002 and 003 were installed in 1961 and 1915, respectively. At that time, intake design flows were significantly greater than existing permitted flows. Further reducing permitted flow to less than 0.7 mgd for both outfalls will eliminate potential impacts associated with impingement of aquatic life and also reduce potential impacts associated with entrainment. Therefore, operation of these structures is not anticipated to pose a significant adverse impact on the aquatic resources of the lower Charles River.

Appendix 2 of the General Permit indicates that there are four listed species of concern to facilities seeking permit coverage, namely the shortnose sturgeon, the dwarf wedge mussel, the bog turtle, and the northern redbelly cooter. The shortnose sturgeon is listed under the jurisdiction of NOAA Fisheries and the dwarf wedge mussel, the bog turtle, and the northern redbelly cooter are listed under the jurisdiction of the U.S. Fish and Wildlife Service. None of the above species are believed to be present within the lower Charles River Basin. Therefore, no adverse impacts to these species are anticipated.

Your review relative to threatened or endangered species is greatly appreciated. The US Fish and Wildlife Service (US FWS) and the National Marine Fisheries Service (NMFS) have also been contacted for input.

TRC would like to thank you in advance for your efforts in reviewing this material. If you have any questions or require further information, please do not hesitate to contact me directly at (978)-656-3570. Thank you for your assistance.

Sincerely,
TRC Environmental Corporation

David E. Schafer
Senior Water Resources Engineer

TRC

TRC

Wannalancit Mills
650 Suffolk Street, Suite 200
Lowell, MA 01854

978.970.5600 PHONE
978.453.1995 FAX

www.TRCsolutions.com

October 1, 2008

NOAA Fisheries Service
Northeast Region, Protected Resource Division
Attn: Endangered Species Coordinator
One Blackburn Drive
Gloucester, MA 01930

Ref: Massachusetts Institute of Technology, Notice of Intent for Coverage Under the Massachusetts General Permit for Non-Contact Cooling Water – Threatened or Endangered Species Review

Dear Environmental Reviewer:

The Massachusetts Institute of Technology (MIT) is preparing a Notice of Intent (NOI) to seek coverage under the National Pollutant Discharge Elimination System General Permit for Non-Contact Cooling Water (Permit No. MA250000). General permit coverage is being requested for two existing intake and outfall structures, designated 002 and 003, located along the Charles River in Cambridge, Massachusetts. An intake and outfall location map is attached as Figure 1. Figure 2 shows the intake and outfall locations on an aerial photograph of the site and surrounding area. In accordance with NOI filing requirements, this letter requests agency input relative to threatened or endangered species in the project vicinity, designated critical habitat or essential fish habitat that may potentially be impacted by the operation of these structures.

Authorization to discharge non-contact cooling water was granted to MIT in 1974 under NPDES Permit No. MA0000795. The permit covered four outfalls, designated 001, 002, 003, and 004. Outfalls 001 and 004 are no longer used for the discharge of once through cooling water by MIT and there are no plans to use these outfalls for non-contact cooling water at this time. Outfall 002, which addressed non-contact cooling water for the Magnet Laboratory and for air conditioning, is currently active and will continue to be operated on an intermittent basis for equipment cooling. Outfall 003, which was used primarily for power plant non-contact cooling, is no longer required for electric power generation, but is scheduled for reactivation to support engine research efforts directed at improving fuel economy and operating efficiency.

MIT's existing NPDES permit authorizes the discharge up to 6.0 million gallons per day (mgd) of non-contact cooling water through Outfall 002 and up to 6.72 mgd from Outfall 003. Current non-contact cooling water requirements for Outfall 002, totaling up to 0.18 mgd, are significantly less than under the existing NPDES permit. It should also be noted that this outfall is only required on an intermittent basis to support research efforts. Therefore, MIT is requesting that the maximum daily flow for Outfall 002 be reduced from 6.0 mgd to 0.18 mgd. The average monthly flow for this outfall will be considerably less. Projected future non-contact cooling water requirements for Outfall 003 are anticipated to total 0.5 mgd to support engine research activities. Therefore, MIT is requesting that the maximum daily flow for Outfall 003 be reduced from 6.72 mgd to 0.5 mgd. With these reductions in the maximum daily discharge flow coupled with deactivation of Outfalls 001 and 004, the total non-contact cooling water flow for the Facility will be less than 0.7 mgd.

Under the Massachusetts General Permit for Non-Contact Cooling Water, the discharge from Outfalls 002 and 003 is required comply with the following:

- The maximum daily discharge temperature cannot exceed 83°F;
- The discharge cannot raise the receiving water temperature by more than 5°F;
- The Total Residual Chlorine (TRC) concentration in the discharge must comply with applicable water quality based limits;
- The pH of the discharge must be greater than or equal to 6.5 S.U. and less than or equal to 8.3 S.U., unless this range is expanded to the Federal limit of 6.0 S.U. to 9.0 S.U. with the concurrence of MassDEP and EPA; and
- The pH of the discharge shall not be more than 0.5 S.U. outside the background range of the receiving water.

For operation of an intake structure, the applicant must also comply with the general permit's requirements for using the "Best Technology Available (BTA)" for minimizing potential adverse impacts associated with impingement and entrainment of aquatic life. The intake structures associated with Outfalls 002 and 003 were installed in 1961 and 1915, respectively. At that time, intake design flows were significantly greater than existing permitted flows. Further reducing permitted flow to less than 0.7 mgd for both outfalls will eliminate potential impacts associated with impingement of aquatic life and also reduce potential impacts associated with entrainment. Therefore, operation of these structures is not anticipated to pose a significant adverse impact on the aquatic resources of the lower Charles River.

Appendix 2 of the General Permit indicates that there are four listed species of concern to facilities seeking permit coverage, namely the shortnose sturgeon, the dwarf wedge mussel, the bog turtle, and the northern redbelly cooter. The shortnose sturgeon is listed under the jurisdiction of NOAA Fisheries and the dwarf wedge mussel, the bog turtle, and the northern redbelly cooter are listed under the jurisdiction of the U.S. Fish and Wildlife Service. None of the above species are believed to be present within the lower Charles River Basin. Therefore, no adverse impacts to these species are anticipated.

Your review relative to threatened or endangered species is greatly appreciated. The Massachusetts Natural Heritage & Endangered Species Program and the US Fish and Wildlife Service have also been contacted for input.

TRC would like to thank you in advance for your efforts in reviewing this material. If you have any questions or require further information, please do not hesitate to contact me directly at (978)-656-3570. Thank you for your assistance.

Sincerely,
TRC Environmental Corporation

David E. Schafer
Senior Water Resources Engineer

TRC

Wannalancit Mills
650 Suffolk Street, Suite 200
Lowell, MA 01854

978.970.5600 PHONE
978.453.1995 FAX

www.TRCsolutions.com

October 1, 2008

Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, MA 02125

Ref: Massachusetts Institute of Technology, Notice of Intent for Coverage Under the Massachusetts General Permit for Non-Contact Cooling Water – National Historic Preservation Act Review

Dear Environmental Reviewer:

The Massachusetts Institute of Technology (MIT) is preparing a Notice of Intent (NOI) to seek coverage under the National Pollutant Discharge Elimination System General Permit for Non-Contact Cooling Water (Permit No. MA250000). General permit coverage is being requested for two existing intake and outfall structures, designated 002 and 003, located along the Charles River in Cambridge, Massachusetts. An intake and outfall location map is attached as Figure 1. Figure 2 shows the intake and outfall locations on an aerial photograph of the site and surrounding area. In accordance with NOI filing requirements, this letter requests agency input relative to historic properties in the project vicinity.

Facilities seeking coverage under the Non-Contact Cooling Water General Permit must not adversely affect properties listed or eligible for listing in the National Registry of Historic Places under the National Historic Preservation Act of 1966, 16 USC Sections 470 et seq. In addition, facilities must comply with applicable State, Tribal and local laws concerning the protection of historic properties and places and facilities seeking coverage are required to coordinate with the State Historic Preservation Officer and/or Tribal Historic Preservation Officer and others regarding effects of their discharges on historic properties.

Authorization to discharge non-contact cooling water was granted to MIT in 1974 under NPDES Permit No. MA0000795. The permit covered four outfalls, designated 001, 002, 003, and 004. Outfalls 001 and 004 are no longer used for the discharge of once through cooling water by MIT and there are no plans to use these outfalls for non-contact cooling water at this time. Outfall 002, which addressed non-contact cooling water for the Magnet Laboratory and for air conditioning, is currently active and will continue to be operated on an intermittent basis for equipment cooling. Outfall 003, which was used primarily for power plant non-contact cooling, is no longer required for electric power generation, but is scheduled for reactivation to support engine research efforts directed at improving fuel economy and operating efficiency.

MIT's existing NPDES permit authorizes the discharge up to 6.0 million gallons per day (mgd) of non-contact cooling water through Outfall 002 and up to 6.72 mgd from Outfall 003. Current non-contact cooling water requirements for Outfall 002, totaling up to 0.18 mgd, are significantly less than under the existing NPDES permit. It should also be noted that this outfall is only required on an intermittent basis to support research efforts. Therefore, MIT is requesting that the maximum daily flow for Outfall 002 be reduced from 6.0 mgd to 0.18 mgd. The average monthly flow for this outfall will be considerably less. Projected future non-contact cooling water requirements for Outfall 003 are anticipated to total 0.5 mgd to support engine research activities. Therefore, MIT is requesting that the maximum daily flow for Outfall 003 be reduced from 6.72 mgd to 0.5 mgd. With these reductions in the maximum daily discharge flow coupled with deactivation of Outfalls 001 and 004, the total non-contact cooling water flow for the Facility will be less than 0.7 mgd.

The existing intake and outfall structures are not visible from either the shoreline or the river. In addition, no construction activities in the vicinity of these structures are anticipated.

Under the Massachusetts General Permit for Non-Contact Cooling Water, the discharge from Outfalls 002 and 003 is required comply with the following:

- The maximum daily discharge temperature cannot exceed 83°F;
- The discharge cannot raise the receiving water temperature by more than 5°F;
- The Total Residual Chlorine (TRC) concentration in the discharge must comply with applicable water quality based limits;
- The pH of the discharge must be greater than or equal to 6.5 S.U. and less than or equal to 8.3 S.U., unless this range is expanded to the Federal limit of 6.0 S.U. to 9.0 S.U. with the concurrence of MassDEP and EPA; and
- The pH of the discharge shall not be more than 0.5 S.U. outside the background range of the receiving water.

For operation of an intake structure, the applicant must also comply with the general permit's requirements for using the "Best Technology Available (BTA)" for minimizing potential adverse impacts associated with impingement and entrainment of aquatic life. The intake structures associated with Outfalls 002 and 003 were installed in 1961 and 1915, respectively. At that time, intake design flows were significantly greater than existing permitted flows. Further reducing permitted flow to less than 0.7 mgd for both outfalls will eliminate potential impacts associated with impingement of aquatic life and also reduce potential impacts associated with entrainment. Therefore, operation of these structures is not anticipated to pose a significant adverse impact on the aquatic resources of the lower Charles River.

Because the NOI requests a reduction in current permitted flows through existing structures, the structures are not visible from the shoreline or river, and no new construction activity is envisioned, potential impacts to historic properties are not anticipated.

Your review relative to compliance with the National Historic Preservation Act requirements is greatly appreciated. TRC would like to thank you in advance for your efforts in reviewing this material. If you have any questions or require further information, please do not hesitate to contact me directly at (978)-656-3570. Thank you for your assistance.

Sincerely,
TRC Environmental Corporation

David E. Schafer
Senior Water Resources Engineer